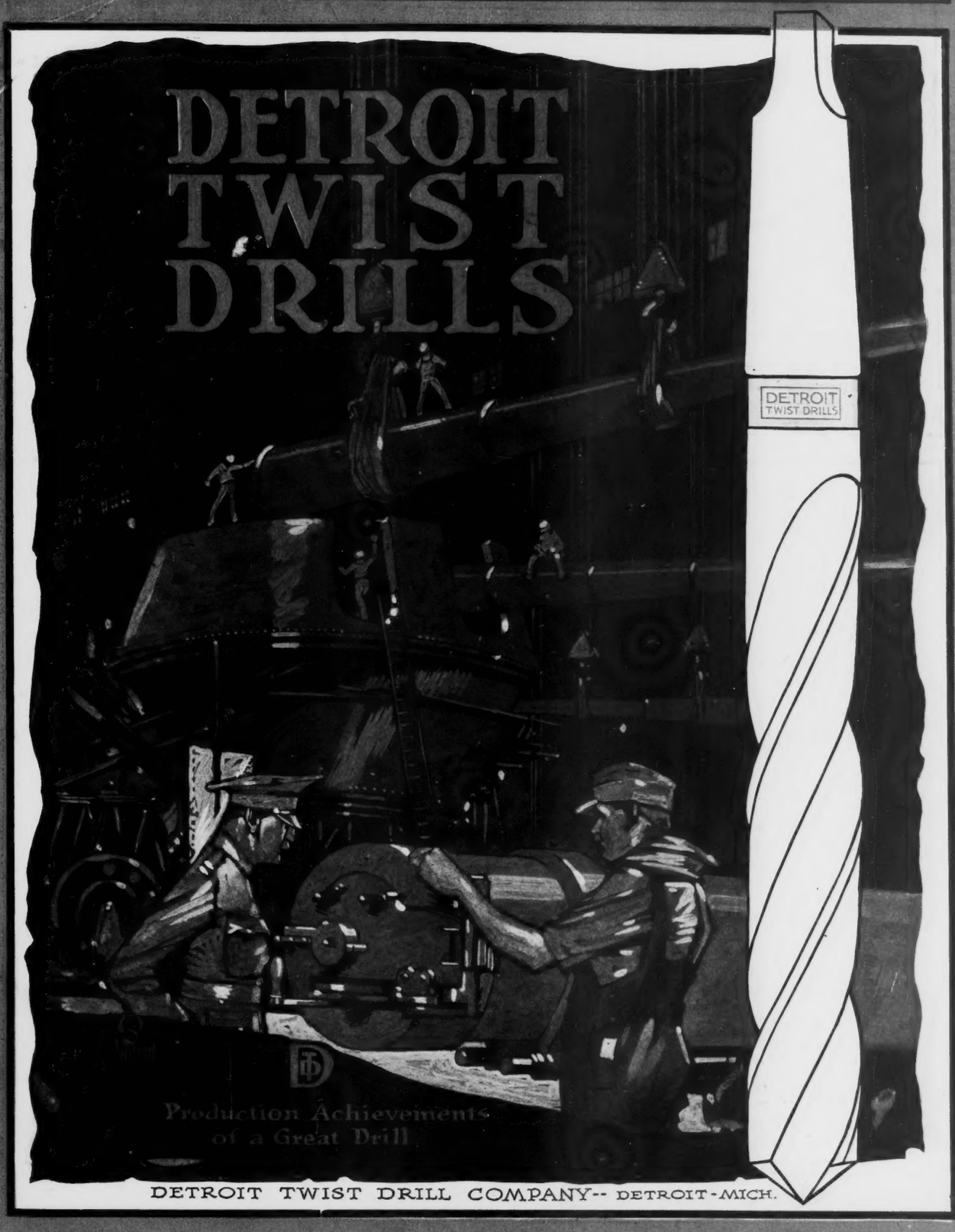
VOLUME 24 AUGUST 1918 NUMBER 12

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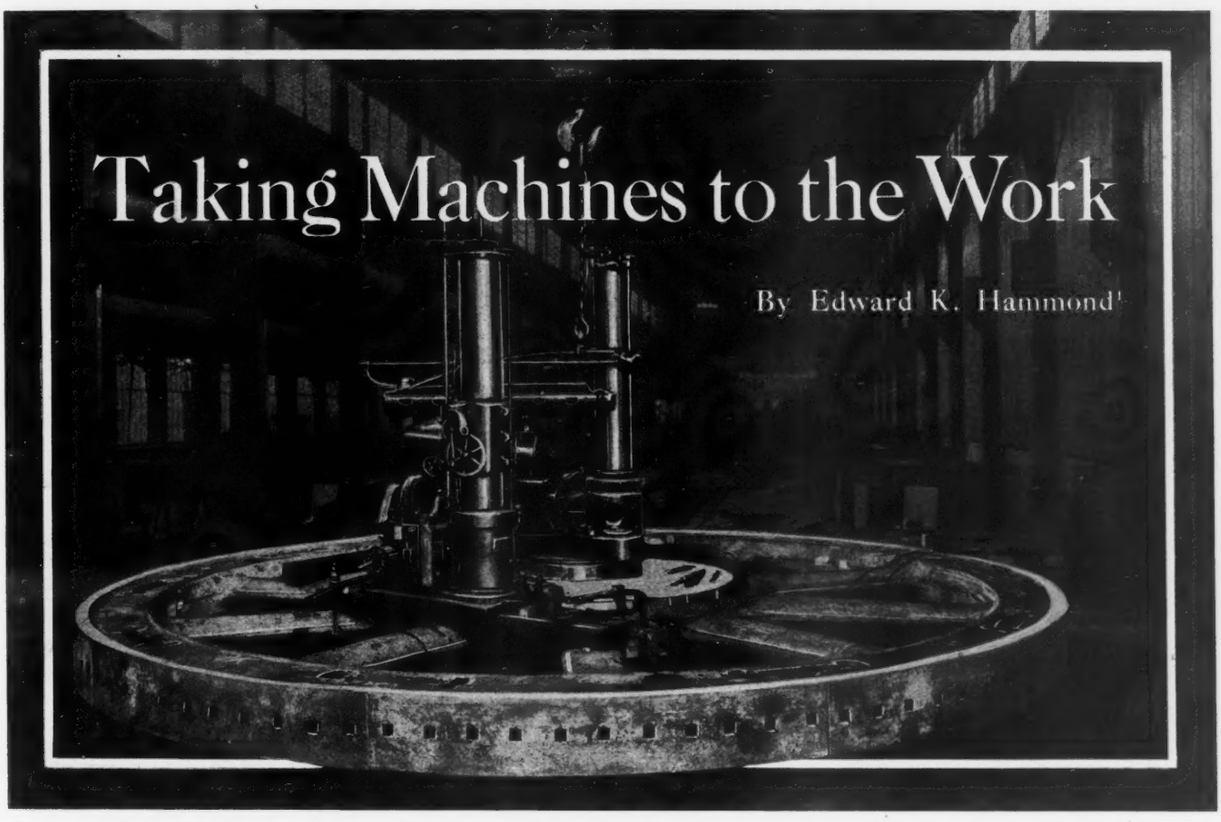
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AUGUST MACHINERY 1918



Taking Machines to the Work

By Edward K. Hammond[1]

In planning methods of handling government work which involves the performance of machining operations on pieces of large size and heavy weight, careful consideration has been given to the possibility of using portable machines which are carried to the work instead of following the usual method of taking the pieces which are to be machined to stationary machine tools. This article explains methods used by prominent manufacturers for applying portable machines in the performance of shop operations and describes various advantages that are secured through their use. It will suggest ways in which the same principle could be applied by manufacturers who are at present working out methods of machining heavy work for the Government.

FACTORIES engaged in building power plant engines and similar equipment, where a year's business seldom includes orders for many engines or other products of the company which are of the same design, must handle their work differently from plants engaged in manufacturing large numbers of a standard product. In such factories, the highly organized manufacturing practice of shops engaged in the performance of repetition work on large numbers of similar parts is replaced by methods developed with the view of saving time and labor in handling extremely heavy castings, in utilizing floor space, and in saving as much time as possible in the actual performance of machining operations. There are many factories in which all of these results are secured through the use of portable tools that are taken to the work instead of following the usual practice of taking work to stationary machines; and in the present article it is intended to explain the beneficial results which certain manufacturers have secured through adopting the use of portable tools.

In addition to their use on production work, portable machines are often employed to advantage on repair work and for making slight alterations on factory equipment. In such cases, the great advantage derived from the use of a portable machine lies in the fact that it is often found possible to set it up on a shaft or other machine member without the necessity of removing the part to be machined from its operating position. Obviously, where such a practice can be followed it is the means of saving a substantial amount of time which would otherwise be consumed in tearing down the machine, transferring the member to be repaired to the machine shop, and then bringing the part back and setting it up in place after the machining operation has been completed. There are many examples of this kind that are familiar to the average mechanic, among which may be cited the re-boring of engine cylinders, re-turning of crankpins, and cutting of keyways in shafts.

In this article four classes of portable machines will receive consideration: (1) Machine tools intended for the performance of production machining operations on general classes of work, which are either mounted on wheels so that they may be pulled about the shop, or provided with convenient means of carrying from place to place with a traveling crane. (2) Special-purpose machine tools, such as portable cylinder boring-bars, portable keyseating machines, etc. (3) Electric or pneumatic tools which are of such small size that they may be easily carried; these are adapted for general classes of work. (4) Tools of the same general type as those referred to under (3), but which are intended for the performance of specific operations, such as grinding lathe centers, grinding shear blades, etc., while set up on the machine.

Electric Traveling Cranes Used to Carry Portable Machines

In shops engaged in building engines and similar work, where there are exceedingly heavy castings to be handled, an important advantage may be secured through the use of portable machines, owing to the possibility of obviating difficulty that is likely to be experienced in setting up these heavy castings on stationary machine tools. With portable machines of the proper design it is often found possible to take the machine to the work and set it up in position for performing a given operation in far less time than would be consumed in carrying the work to a machine. This will be obvious when

[1] Associate Editor of MACHINERY.

one bears in mind that the machine is likely to weigh from 1500 to 4000 pounds, so that it is easily carried by a crane, while an engine bed casting or similar part will often weigh from 50 to 75 tons.

An example of this kind is seen at the plant of the Mesta Machine Co., in Pittsburg, Pa. This shop is engaged in building steam and gas engines, condensers and air pumps, rolling mill machinery, and similar heavy equipment. It is not unusual for some of the castings that must be machined to weigh in excess of seventy-five tons, so that they are too large for the capacity of one crane. Aside from the extreme difficulty of transferring heavy work of this kind, the use of portable machines allows several machines to be operating on a casting at the same time, which is a matter of importance when the execution of rush orders is in question. In the case of these excessively large pieces, it would be out of the question to attempt to set them up on an ordinary machine tool; but the trouble has been effectually overcome by adopting the use of portable machines. The heading illustration shows a view in the Mesta plant, where two radial drilling machines built by the American Tool Works Co., of Cincinnati, Ohio, are at work on a flywheel casting, the simultaneous use of two machines providing for unusually rapid handling of the work.

In the plant of the Allis-Chalmers Mfg. Co., in Milwaukee, Wis., the same general conditions exist which have been outlined in the case of the Mesta Machine Co.'s shops. For the performance of machining operations on large engine frame castings, etc., the Allis-Chalmers production engineers have adopted the use of portable traveling-head planers built by the Morton Mfg. Co., of Muskegon Heights, Mich. It will be apparent from Figs. 1 and 2 that both the work and portable machines used in these shops are set up on floor plates which provide an accurate foundation. An advantage of these traveling-head planers for such work as machining engine frames lies in the wide range of machining operations for which they are adapted. Primarily, these machines are "draw-cut" planers with the tool-head mounted on a reciprocating ram; but adjustment may be rapidly made to provide for having the tool cut on the forward stroke if so desired, and, in addition, attachments are provided which adapt planers of this type for the performance of boring, drilling, milling, and rotary planing operations. From this it will be evident how useful the machines are found for carrying on those operations which are met with in machining large engine frames and similar classes of work. Fig. 1 shows a large traveling-head planer at work planing the joint in a pillow-block of a large Allis-Chalmers engine, while at each side of this machine there will be seen two smaller sized tools engaged in drilling.

In this connection, the reader's attention is directed to the provision made for adjusting the position of the column on the bedplate of the machine, and for regulating the location of the saddle on the column, in order to provide for reaching any position on pieces of work of considerable size. Fig. 2 illustrates the same job taken from the opposite end, where it will be seen that, in addition to the three Morton machines, there are a radial drilling machine and a special facing head working on this engine casting. This brings out to excellent advantage the idea of saving time through having a number of machines at work on one casting at the same time. Figs. 3 and 4 illustrate detail views of provision made for the performance of milling and boring operations with the Morton traveling-head planers. These attachments for the Morton traveling-head planers have been described in MACHINERY, so that a detailed description of the mechanism is not called for. It will be of interest to note, however, that the design has been worked out in such a way that the attachments may be quickly applied or removed from the machines.

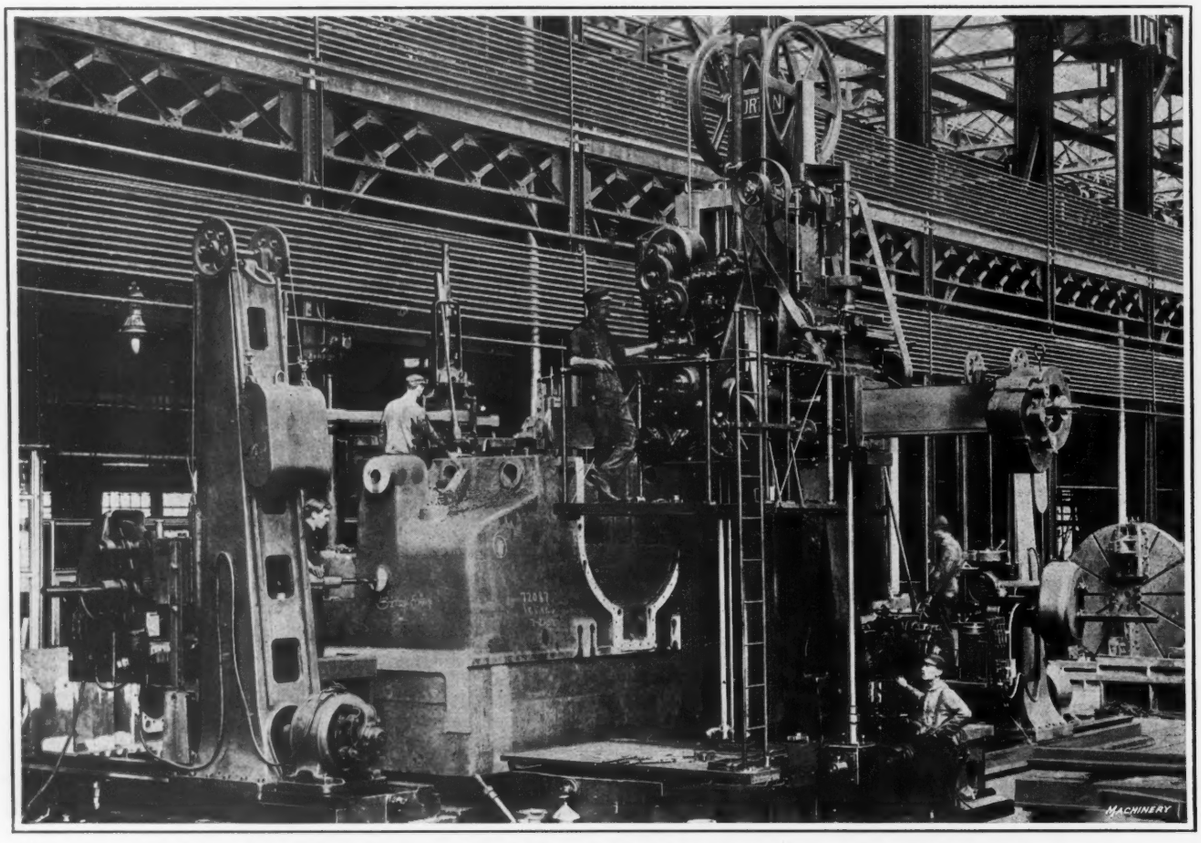


Fig. 1. View in Shops of Allis-Chalmers Mfg. Co., showing Three Morton Portable Traveling-head Planers working on Engine Bed Casting

For handling certain operations at the plant of the Canadian General Electric Co., in Peterboro, use is made of an 84-inch-stroke portable slotting machine built by the Newton Machine Tool Works, 23rd and Vine Sts., Philadelphia, Pa. One of these machines is shown in operation in Fig. 5, where it will be seen that a yoke is furnished at the top of the column to enable the machine to be readily picked up by the hook of a traveling crane, which is used to transport it from one part of the shop to another. This machine is equipped with reversing electric motor drive, so that it may be connected to a power circuit in any part of the shop where it is to be used. These portable slotting machines are built in several types, with strokes from 36 to 96 inches, inclusive.

Portable Machines Mounted on Wheels

The portable machines to which attention has been called up to the present time are of the type that are adapted for transfer around the shop with a traveling crane, and they are intended to be set up on a floor plate on which the work is also mounted in order to obtain a solid foundation, which is essential if it is hoped to obtain accurate alignment of the various bearings and finished surfaces on the work. There is another type of portable machine which is mounted on wheels so that it can be pulled around the shop like a truck. An example of this kind of equipment is illustrated in Fig. 10, which shows a portable engine lathe built by the R. K. LeBlond Machine Tool Co., of Cincinnati, Ohio. In handling the work of railroad shops, arsenals, and on board battleships, it is often found desirable to have a portable lathe which can be readily moved from one position to another, so that the lathe will be available for the performance of turning and boring operations on parts which are being repaired, or for making new pieces to replace parts which have been so badly damaged that they are unfit for further service. The application of portable lathes is limited to handling repair work and to other cases where an occasional machining operation has to be performed; obviously, they are not adapted to the requirements of manufacturing plants where lathes are engaged in the performance of repetition work. In Fig. 10 there is shown the method of applying constant-speed motor drive on a portable lathe, and owing to the conditions under which a machine of this type is used, it will be apparent that an individual electric motor constitutes the ideal method of driving. This lathe swings 17 inches and is furnished with an all-geared headstock, all changes of speed being made by shifting gears in the head. The motor is mounted at the back of the machine and the drive is through a Morse silent chain, which is completely enclosed. The spindle is started and stopped mechanically from the apron, and the electrical equipment consists of a slate-front starting panel in cases where a direct-current motor is employed. An alternating-current motor can also be used, and if so, a starter is not required. Lathes of this type can be equipped for screw cutting or they may be furnished with a sliding gear feed mechanism. The handle at the end of the machine is counterweighted in such a way that when it is released it rises to a vertical position and causes the machine to be secured to the floor. With the handle in the vertical position that it occupies at such times, the machine takes up no more space than a standard lathe. Although this type of lathe is built only in 17-inch swing, the R. K. LeBlond Machine Tool Co. builds another type of portable lathe, which is furnished in 14-, 16-, 17-, and 19-inch sizes.

Carrying Machines on Elevating Trucks

So far we have considered the advantages of portable machines for performing operations on work of such large size that difficulty would be experienced in carrying it about the shop and setting it up on stationary machine tools. Another important advantage of the portable machine lies in the fact that in cases where it is only required at intervals, it may be stored in some out-of-the-way place when it is not in use. A good case of this kind is seen in the plant of S. F. Bowser &

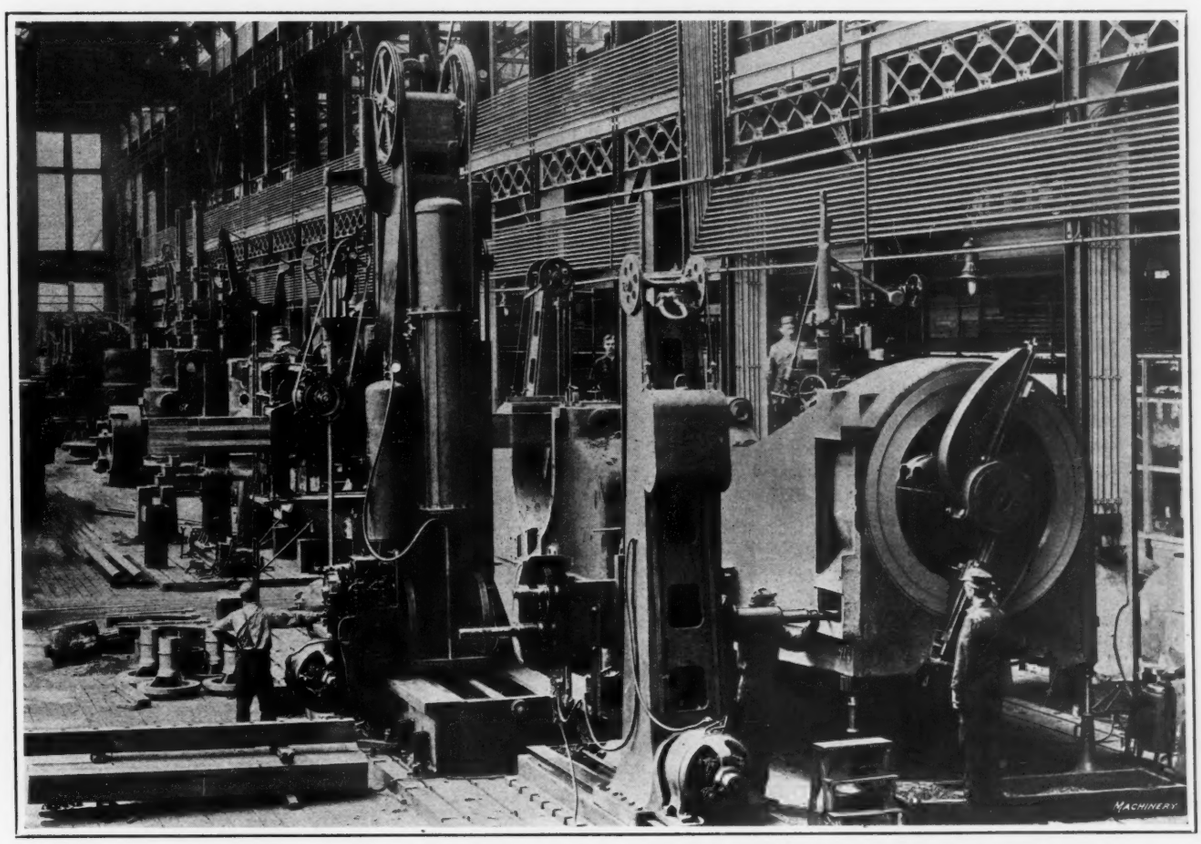


Fig. 2. View from Opposite Side of Work illustrated in Fig. 1, showing Radial Drilling Machine and Facing Head working on Same Casting

Co., Inc., of Fort Wayne, Ind. In the manufacture of parts for gasoline pumps, this firm uses a battery of twenty-eight high-duty Baker drilling machines which are tooled up for performing operations that would ordinarily be handled on turret lathes. The idea is to transfer work from one machine to another, instead of rotating a turret to bring successive tools into the operating position.

In connection with the production of certain parts machined on this equipment, the bearing is bored and reamed to receive a brass insert, after which it is required to press this insert into place on an arbor press, and then ream the hole in the brass bushing. Time would be lost if it were necessary to first transfer the work to an arbor press located in some other part of the shop and then bring it back to the drilling machines for the performance of the final operations. At the same time, the parts into which these brass inserts have to be pressed are only machined at intervals of several weeks, and if the arbor press was permanently located beside the battery of drilling machines, it would be taking up valuable space during a great majority of the time when it was not in use. This difficulty has been effectually overcome by adopting the use of a portable arbor press, which consists of a machine

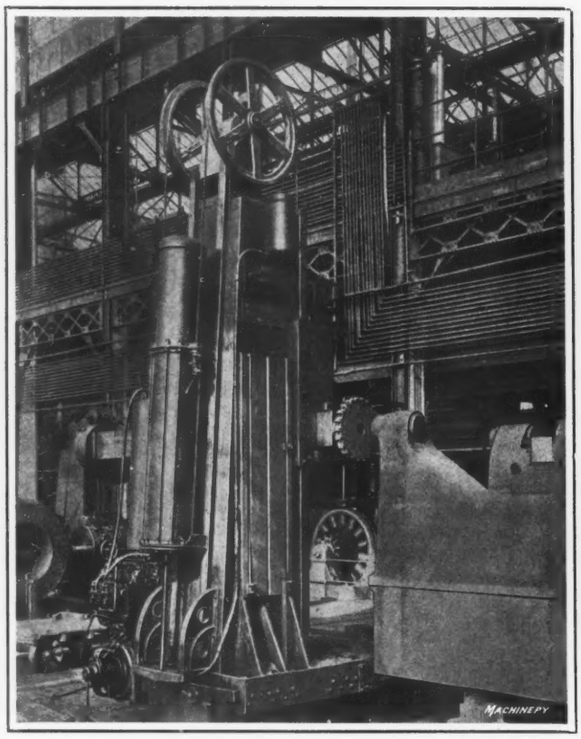


Fig. 3. Morton Traveling-head Planer equipped for performing Milling Operation on Allis-Chalmers Engine Bed

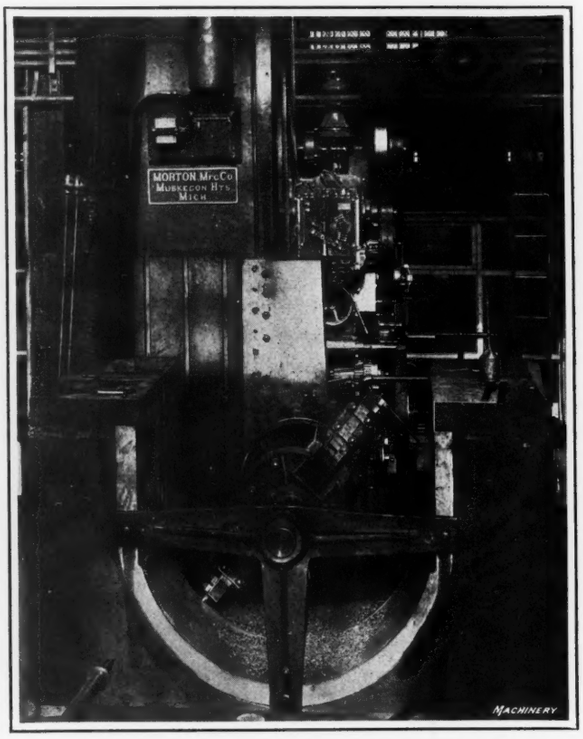


Fig. 4. Morton Traveling-head Planer equipped for performing Boring Operation on Allis-Chalmers Engine Bed

built by the Lucas Machine Tool Co., of Cleveland, Ohio, mounted on a skid so that it may be carried on an elevating truck. In this way, it is an easy matter to bring the arbor press up into line with the drilling machine on which the reaming operation is performed, preparatory to pressing the bushing into place, and when these bushings have been pressed into all of the parts to be machined, the arbor press is taken away to a position in the shop where it can be stored without being in the way of any of the machine operators.

Similar advantages are secured in the Bowser shops through the use of a tapping machine built by the Garvin Machine Co., of New York City, which is mounted on a skid for transfer with an elevating truck. In operating the battery of high-duty drilling machines, to which reference has been made, it has been found advisable to divide the machines into groups of four and to never have more than four machines working on any one job. It quite often happens that separating the machines into groups of four works out in such a way that there is a tapping operation to be performed for which a machine is not available. This is particularly the case on parts where there are, say, five, nine, or thirteen operations to be performed, that is, where there is one operation in excess of some multiple of four. In such cases, the work is divided into groups of four operations and the odd tapping operation is taken care of by the portable machine, which is brought up to the proper place in the shop, while it is actually required, and then taken away at once, so that it does not obstruct the shop at other times.

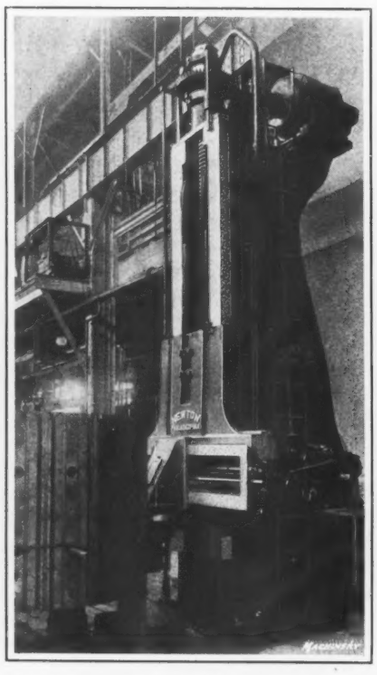


Fig. 5. Newton Portable Slotting Machine with 84-inch Stroke, used in Plant of Canadian General Electric Co.

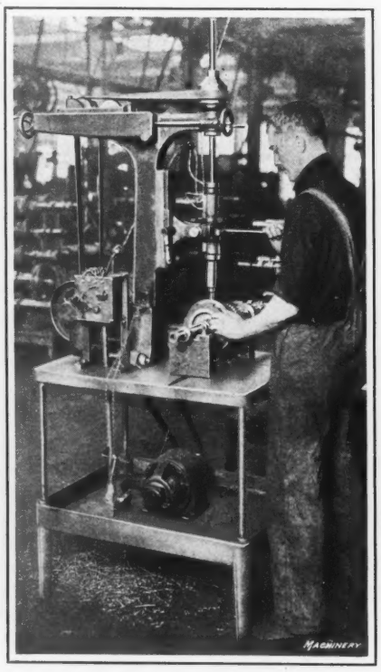


Fig. 6. Portable Drilling Machine used in Headstock Assembling Department of Jones & Lamson Machine Co.

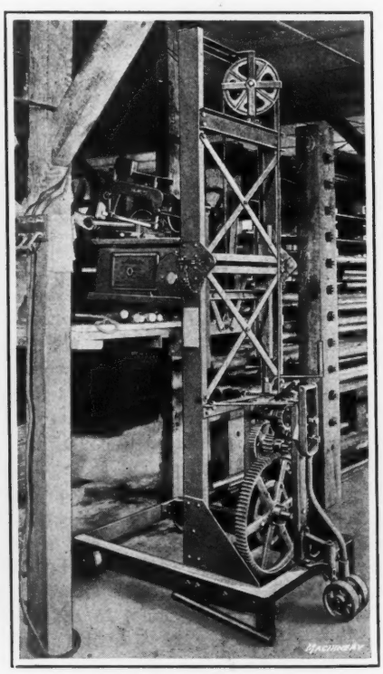


Fig. 7. Economy Portable Elevator supporting Racine Hacksaw Machine for cutting Bar Steel in Racks

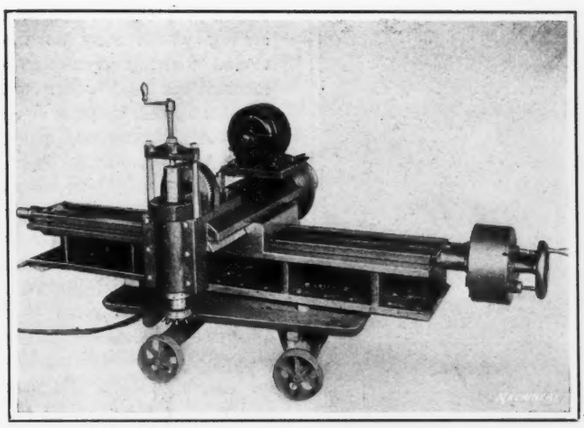


Fig. 8. Portable Milling Machine made by the Pedrick Tool & Machine Co.

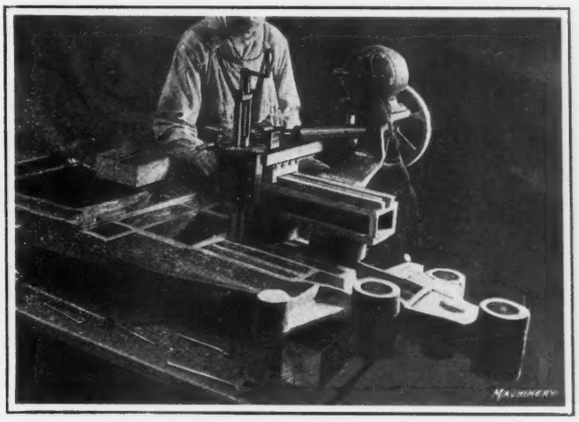


Fig. 9. Smaller Type of Pedrick Portable Milling Machine in Use

Somewhat similar use is made of portable machines in the headstock assembling department of the Jones & Lamson Machine Co.'s factory, in Springfield, Vt. This firm has worked out its methods in such a way that all parts required by the men employed in this department are delivered to them to avoid loss of time which would result through having employes go to the stock-room to get the necessary supplies. In assembling headstocks in this shop, there are certain minor machining operations which have to be performed after the work is partially set up, a case in point being the drilling of pin-holes. Carrying out the same idea of avoiding loss of time on the part of men employed in assembling, the idea was conceived of using portable drilling machines in the assembling department, which could be taken right to the spot where a man is working at the time he has drilling to do. With the use of such machines, the workman can use an elevating truck to take the drilling machine to his bench and perform all drilling operations on the parts in which holes must be machined, thus avoiding the necessity of going back and forth between his bench and the machine. Then when the next man is ready to start drilling, he can take the machine to his bench. Fig. 6 shows one of the portable drilling machines in use in the Jones & Lamson shops.

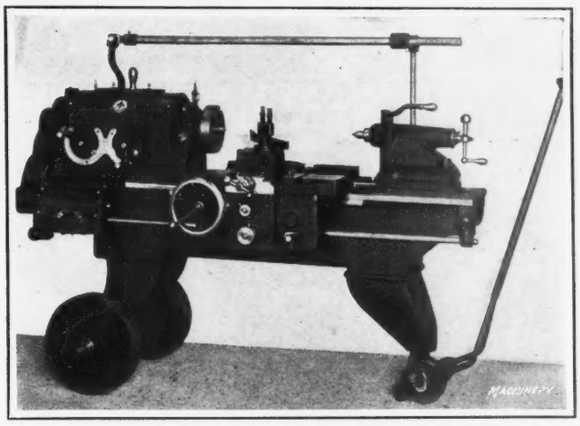


Fig. 10. R. K. LeBlond Portable Engine Lathe adapted for Use in Railroad Shops, Arsenals, on Board Battleships, etc.

Mounting Machine on Portable Elevator

Doubtless there are men who have been through a great many American manufacturing plants without seeing any important use that has been made of portable machines for cutting up bar stock. Still there is a field for the portable machine in doing this work. An interesting example is shown in Fig. 7, where it will be seen that a hacksaw machine is set up on the platform of a portable elevator or "tiering machine" built by the Economy Engineering Co., of Chicago, Ill., to provide for cutting off short lengths of tool steel carried in the familiar form of rack, without requiring the long bars to be pulled out of the rack and taken to a machine on the floor. Not only is this the means of saving the time of one or more men who would be required to do this work, but it also saves confusion and consequent delay sometimes caused in a shop through having long pieces of steel moved around in it. This outfit is used at the plant of the Mechanical Appliance Co., in Milwaukee, Wis., where it has been found the means of saving enough time to fully warrant the use of this special equipment.

Portable Milling Machines

In Figs. 8 and 13 there is shown a portable type of milling machine built by the Pedrick Tool & Machine Co., 3639 Lawrence St., Philadelphia, Pa. This machine was designed for the performance of miscellaneous milling operations where it is more desirable to take the machine to the work than to set the work up on a stationary milling machine. It has been found particularly useful for truing up hammer blocks, and in Fig. 13 there is shown an illustration of the way in which such an operation is performed. This illustration shows the work of truing up a hammer block in

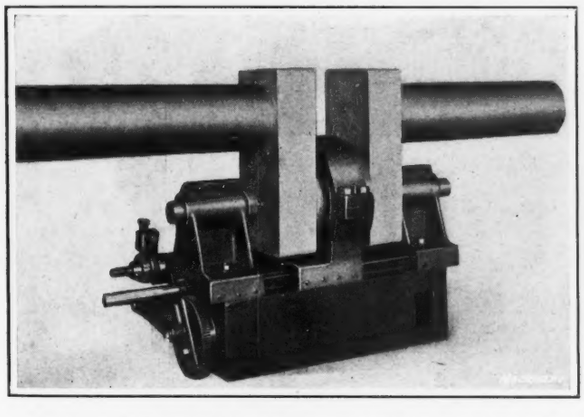


Fig. 11. Pedrick Portable Turning Machine truing up Center Crankpin

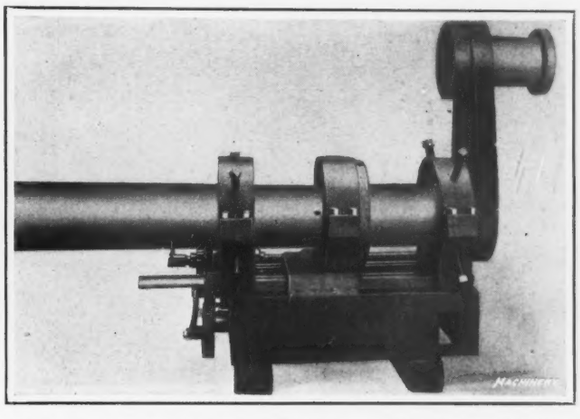


Fig. 12. Pedrick Portable Truing Machine arranged for Turning Operation

the plant of the Spicer Mfg. Co., of South Plainfield, N. J. Evidently the casting on which the milling operation is being performed is of such size and weight that the use of a portable machine, which can be set up on the work without requiring it to be moved, affords a far more efficient method of doing the work than to take this heavy piece to a stationary milling machine. The Pedrick portable milling machine is substantially constructed and an important feature of its design is the simplicity of the feed mechanism. Three changes of feed are available in either direction, for both the longitudinal and cross-feed movements, and the feed mechanism may be operated by either hand or power. Fig. 9 shows a smaller type of portable milling machine built by the Pedrick Tool & Machine Co., engaged in machining recesses in a large casting. Portable machines of this type may be used to advantage for milling pads on large castings and for machining the slide-valve seats of small pumps. In addition to these two typical operations, the machines are used in many other cases where the work is of such a character that it is inconvenient to transport it to a stationary milling machine.

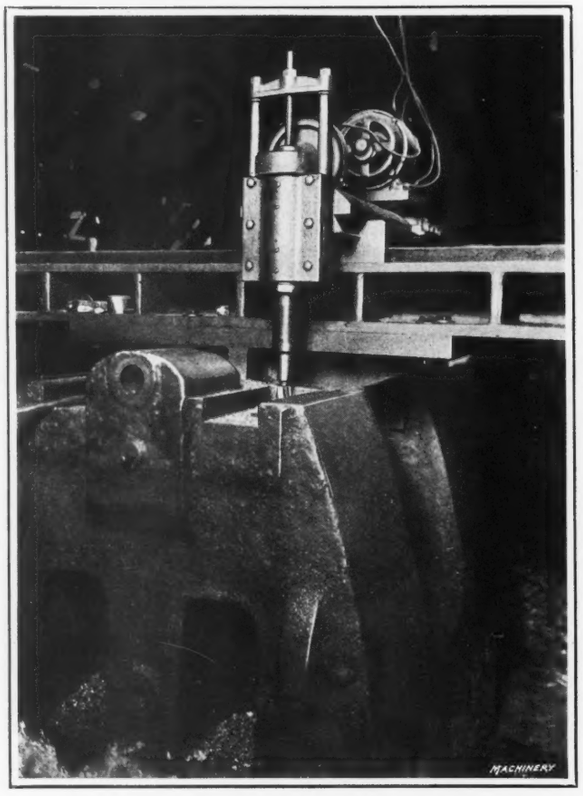


Fig. 13. Pedrick Portable Milling Machine shown in Fig. 8, engaged in truing up Hammer Block in Plant of Spicer Mfg. Co.

Application of Portable Turning and Boring Machines

In Figs. 11 and 12 there are shown two applications of a portable turning and boring machine which is also built by the Pedrick Tool & Machine Co. This machine may be used for a variety of purposes, among which may be mentioned turning crankpins of locomotives and other side-crank engines, turning center crankpins, journals, shafts, and axles, and reboring crankpin holes. In most cases, it is unnecessary to remove the crankshaft or other part from its regular position on an engine, in order that it may be trued up by this portable turning machine. Space is furnished for clamping bars and other means of attaching the machine to the work; and the cutter-head is split to provide for putting it over the work that is to be trued up, and the tailstock may be located at any point along the bed of the machine to meet the requirements of different classes of work. When used for reboring crankpin holes, the tailstock is placed in front of the cutter-head where it affords a rigid guide for the boring-bar. The setting heads are bored concentric with the center of the machine and they are provided with set-screws by which the machine can either be attached to an unworn part or set according to the center in the tailstock to provide for obtaining the desired alignment.

Fig. 11 shows the equipment used for truing up center crankpins. For the performance of this operation, center holes are located and drilled on the outside cheeks of the crank, after which the machine is set up with two tailstocks which engage these center holes. Cutting tools can be used on either side of the cutter-head and where the distance be-

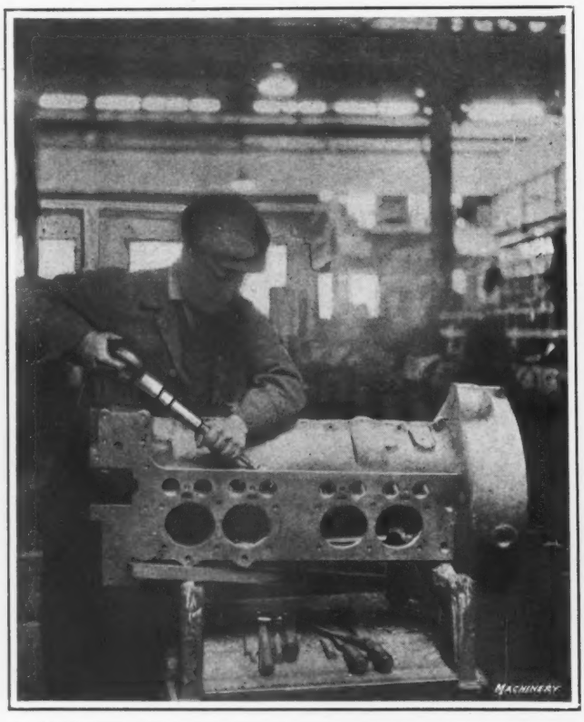


Fig. 14. Snagging an Aluminum Crankcase Casting with Ingersoll-Rand Co.'s "Little David" Pneumatic Hammer in Plant of International Motors Co.

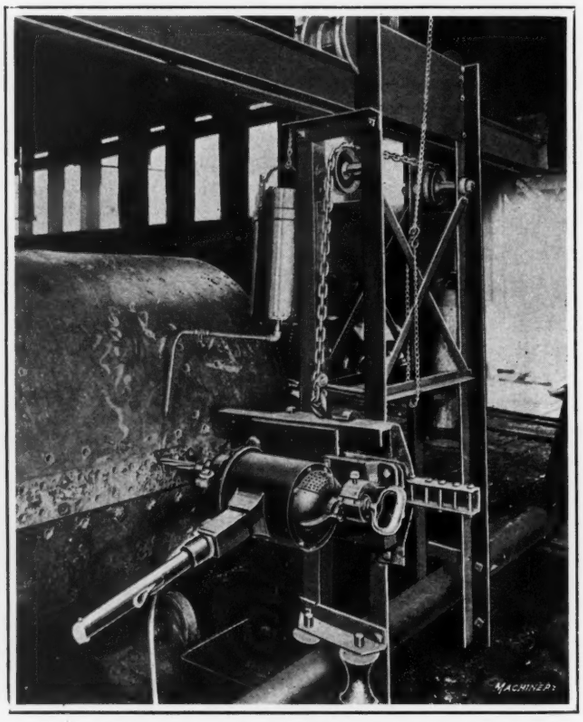


Fig. 15. Equipment developed by Kroeschell Bros. for reaming Holes in Boiler Shells with Electric Drill made by Chicago Pneumatic Tool Co. Vertical and Horizontal Movements enable the Tool to reach All Holes

tween the cheeks is small, a cut can be started at the middle of the pin and run over to one side, after which the tools are placed on the opposite side of the cutter-head and run across to the other cheek of the crankshaft. Fig. 12 shows how the machine is used for truing up large shafts, axles, and similar parts. In this illustration it will be seen that the machine is equipped with two setting heads and a cutter-head, all three of these parts being split so that they may be placed around the work to be trued. The machine may be fitted to the work by set-screws in the setting heads or by making sleeves with their outside diameter the right size to fit the setting heads, and the inside diameter of suitable size for the work. Where the latter method is used, the sleeves are split and placed around the shaft, after which the machine is set up in the usual way. As the setting heads are bored concentric with the machine, the work can be aligned as accurately as if it were chucked in a lathe.

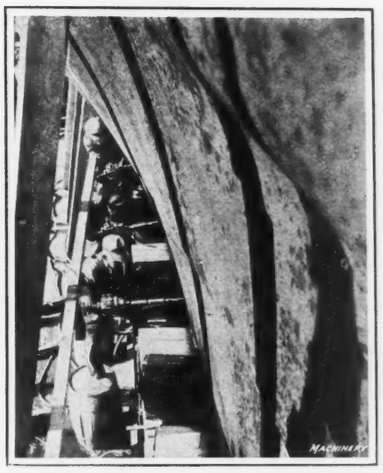


Fig. 16. Portable Tools find Wide Application in handling the Work of Shipyards. In this Picture we see a "Thor" No. 42 Drill, made by the Independent Pneumatic Tool Co., working on a Ship Hull

work than to use an air chipping hammer, and Fig. 14 shows the use of one of the "Little David" tools built by the Ingersoll-Rand Co., of 11 Broadway, New York City, engaged in removing slight imperfections from the surface of an aluminum crankcase casting in the plant of the International Motors Co., in Plainfield, N. J.

Drilling and Reaming with Portable Tools

Reaming holes in boiler shells with an ordinary portable drill is quite a tiresome operation; it is also difficult to hold the reamer squarely against the shell, and unless this is done, accurately reamed holes will not be produced. When the men engaged in this work become tired, they are very apt to let the drill drop slightly, which results in producing oblong shaped holes. To overcome trouble from this cause, E. A. Anderson, superintendent of the boiler department of Kroeschell Bros., of Chicago, Ill., designed a simple frame for holding portable electric or pneumatic drills in the proper position for reaming holes in boiler shells. In Fig. 15 it is shown equipped with a No. 4 Duntley electric drill made by the Chicago Pneumatic Tool Co., 1060 Fisher Bldg., Chicago, Ill., and it will be apparent from this illustration that the tool is rigidly held so that it is impossible to ream the holes inaccurately through movement of the tool while the operation is being performed. Most of the holes to be reamed are from 11/16 to 15/16 inch in diameter, and the plates though which they are reamed are about 1½ inch in thickness. It will be apparent from the illustration that the frame holding the portable electric drill can be adjusted to different angles and that it can also be raised or lowered, a counterweight being provided which facilitates making such adjustments. The frame is made high enough to take boiler shells from 30 to 96 inches in diameter, and sufficient length is provided to enable holes to be reamed in a seam up to 10 feet in

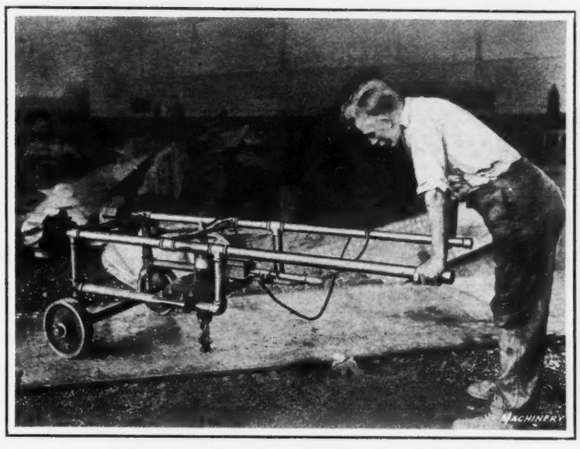


Fig. 17. Van Dorn & Dutton Co.'s Electric Drill supported in Portable Frame developed by Pusey & Jones for drilling Holes in Steel Plates

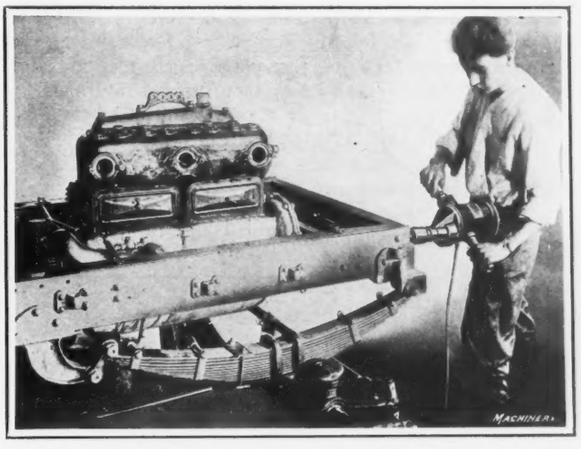


Fig. 18. Hand and Breast Type of Electric Drill made by Standard Electric Tool Co. at Work in a Motor Truck Factory

Use of Portable Electric and Pneumatic Tools

In the previous discussion of advantages secured through the use of portable tools, mention has only been made of those types of machine tools that are arranged for transfer to the work. There is another general class of tools which are driven by power, and these are light enough to be easily carried about the shop. These tools find wide application in the performance of many different machining operations, such as drilling, reaming, grinding, buffing, riveting, etc. They may be either electrically or pneumatically driven. Even where the greatest care is taken in handling foundry work, castings are almost sure to come out of the molds with a number of small burrs and other surface defects which must be removed by snagging. There is no better way of doing this



Fig. 19. Flexible Shafts are used to Advantage for driving Portable Tools. In this Illustration there is shown a Driving Unit, made by the Stow Mfg. Co., driving a Portable Drill

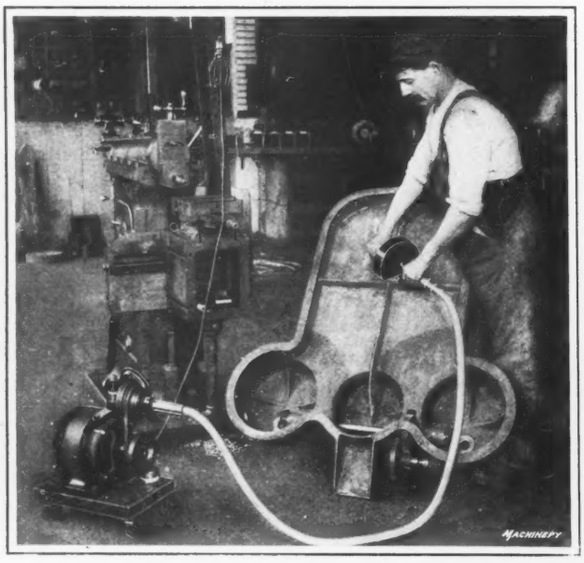


Fig. 20. Flexible Shafts may be used to Equal Advantage for driving Portable Grinding Machines. In this Illustration, Such an Outfit made by R. G. Haskins is shown in Operation

length without requiring the boiler shell to be moved after it has once been set in position. Attention is called to the fact that a tank and delivery pipe provide for supplying lubricant to the reamer and that there is a drip-pan which catches the used lubricant so that it may be utilized many times.

An ingenious application of a portable electric drill made by the Van Dorn & Dutton Co., of Cleveland, Ohio, is illustrated in Fig. 17. This outfit was developed in the shops of Pusey & Jones, of Wilmington, Del., for drilling a large number of holes in a steel plate, and the illustration explains the method of doing the work quite clearly, without calling

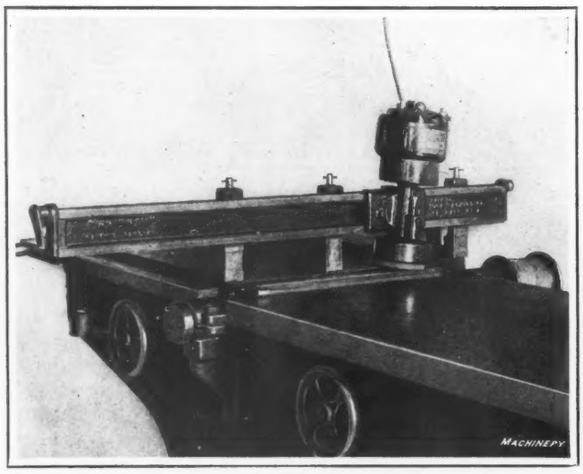


Fig. 21. Much Time can be saved by sharpening the Knives of Woodworking Machinery, etc., if the Work can be done without dismantling. This Illustration shows the "Quick Sharp" Knife Grinder made by the Stockbridge Machine Co. for handling Such Work

for more than a very brief description. It will be seen that the portable electric drill is supported in a frame with two truck wheels at one end and two handles at the opposite end. The holes are first laid out on the steel plate, and then this truck is wheeled around to locate the drill point in the proper positions for drilling successive holes in the work. Feeding the drill is accomplished by simply pushing down on the handles, which results in swinging the frame about a center corresponding to the axle that supports the truck wheels. The radius from the drill point to the axis about which the frame swings is sufficiently great so that the error introduced through this method of feeding is negligible.

Fig. 18 shows one of the portable electric hand and breast drills manufactured by the Standard Electric Tool Co., of Cincinnati, Ohio, in use in a plant engaged in building motor trucks. Standard electric drills are made in all sizes from 3/16 up to 1¼ inch, and like other manufacturers of this type of tools, the Standard Electric Tool Co. provides motors which are adapted for use on either direct- or alternating-current circuits.

There are many cases where the use of portable tools is a matter of absolute necessity. For instance, consider the case shown in Fig. 16, where it is required to drill holes in a hull standing on the ways of a shipbuilding yard. Here the use of a portable machine could not be avoided, and the work is very satisfactorily performed by a "Thor" No. 42

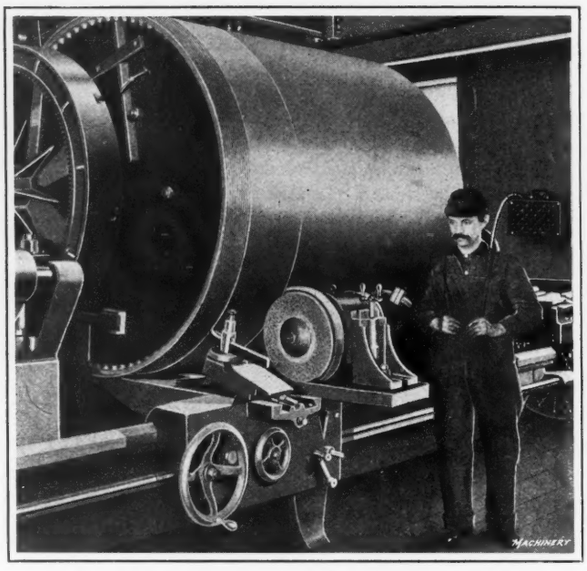


Fig. 22. Portable Tools can often be used to Advantage in Connection with Cutting Tools. Here we see a Portable Grinder made by the Hisey-Wolf Machine Co., working in Conjunction with a Thread Chasing Tool

"shipyard special" drill built by the Independent Pneumatic Tool Co., of Chicago, Ill. This tool weighs only 28 pounds and it may be run at 700 revolutions per minute, the light weight of the tool adapting it for use by one man. This tool is suitable for drilling holes up to 13/16 inch in diameter and for reaming holes up to 15/16 inch in diameter. Among the operations for which it is adapted there may be mentioned the drilling of bull heads, shell clips, intercostals, and the performance of deck-reaming operations.

Application of Flexible Shafts for Driving Portable Tools

Flexible shafts may be used to advantage for driving portable tools. One satisfactory method of using a flexible shaft

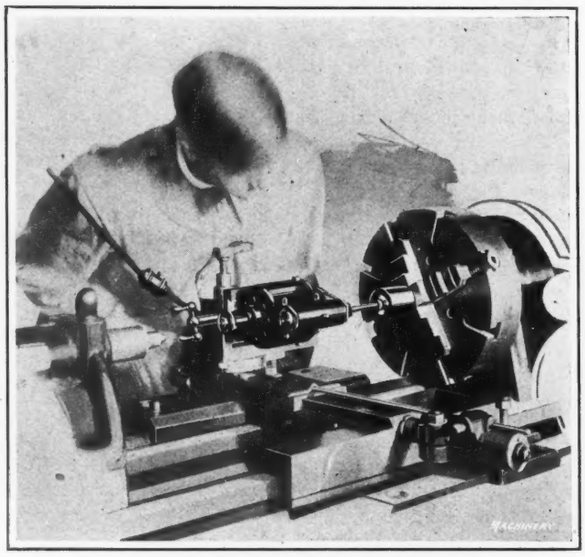


Fig. 23. The "Dumore" Grinder made by the Wisconsin Electric Co. gives Good Results in the Performance of Internal Grinding Operations with the Work and Machine set up on a Lathe as shown in this Illustration

for this purpose is to employ an electric motor for furnishing power and to transmit this power through a flexible shaft to the portable tool. The important advantages of this method are that the weight of the electric motor does not have to be borne by the operator and that the flexible shaft allows considerable latitude for reaching different positions on the work without requiring the driving motor or work to be moved. In Fig. 19 there is shown an outfit built by the Stow Mfg. Co., of Binghamton, N. Y. It will be seen to consist of a truck supporting an electric motor that is furnished with a cable for making connection with the electric power circuit. From the electric motor, power is transmitted to a pulley at one end of the flexible shaft by means of a belt, and the opposite end of this flexible shaft is connected to a portable drilling machine which is light enough so that it can be conveniently carried around the shop to any point where it is to be used. The same arrangement is employed for driving a portable grinding machine built by this company.

In Fig. 20 there is shown another application of the combination of an electric motor and flexible driving shaft, the outfit in this case being connected to a portable grinding machine built by R. G. Haskins, 541 W. Washington Blvd., Chicago, Ill. The use of this flexible shaft drive for a portable grinding machine possesses all of the advantages to which reference was made in connection with the operation of portable drilling machines. In the present case, the grinding machine is shown engaged in the removal of slight surface defects from a casting. The same outfit is used for driving a portable drilling machine built by this manufacturer.

Use of Portable Tools on Stationary Machines

On wood-planing machines and other types of equipment where the necessity arises for sharpening knives, a great deal of time and expense can be saved by the use of a portable grinding machine which may be used to sharpen the knives without requiring them to be removed from the machine on which they are used. A very little thought will be sufficient to show that such a procedure not only saves the expense of labor involved in dismantling the machine and setting it up again after the knives have been sharpened, but that there is an additional advantage through avoiding the necessity for shutting down an expensive machine at times when there is a lot of work for it to do. Trouble is also likely to be experienced through improper adjustment of knives when they are put back into the machine, which results in inefficient operation. Fig. 21 shows a portable knife grinding machine built by the Stockbridge Machine Co., of Worcester, Mass. This machine is driven by an individual electric motor with provision for connecting to any convenient power circuit. It is carried by a saddle furnished with a split nut that engages a feed-screw mounted at the top of the bridge. In this way, the saddle can be fed along the full length of the bridge in either direction and at any desired speed. This bridge is supported at the ends by two angular brackets bolted to the bed of the wood-planing machine, so that the knife grinder is held perfectly rigid. The grinding wheel can be raised or lowered by a thumbscrew and set to grind the required amount from the knives. With an outfit of this kind, sharpening of the machine knives can be quite rapidly accomplished, thus justifying the name "Quick Sharp" which has been given to this portable Stockbridge grinding machine.

In handling work on lathes and other types of machine tools, it will quite often be found advantageous to employ a portable grinding machine in conjunction with the regular cutting tools. A case of this kind is shown in Fig. 22, which illustrates the application of an electrically driven grinding machine built by the Hisey-Wolf Machine Co., of Cincinnati, Ohio, used in conjunction with a tool employed for chasing a thread on a large piece of work set up on the engine lathe. It will be apparent from this illustration that the portable grinding machine is supported by a bracket attached to the lathe carriage, so that this machine finishes the surface of the work while the cutting tool chases the thread at the same traverse of the carriage. Such an arrangement is naturally the means of saving a considerable amount of time because it enables two operations to be performed simultaneously.

Another application of a portable grinding machine in connection with an engine lathe is shown in Fig. 23. In this illustration it will be seen that the grinding machine is engaged in the performance of an internal grinding operation. The machine shown is one of the "Dumore" tools built by the Wisconsin Electric Co., 1431 Dumore Bldg., Racine, Wis., and to provide an efficient cutting speed for the 9/16-inch grinding wheel that is employed, provision is made for driving the spindle at 30,000 revolutions per minute. It will be apparent that provision is also made on this type of grinding machine for the use of a large wheel for the performance of operations where it is not necessary for the wheel to work inside of a hole of limited size.

In many different industries, new uses are constantly being found for portable electric and pneumatic tools. A great deal of time is saved with a corresponding reduction in machining costs, through the use of portable tools on many classes of work; and the possibility of taking a small tool to a heavy piece of work saves time and expense in handling. Another important factor is the avoidance of the necessity of lifting a large piece of work with a crane and carrying it through the shop to a stationary drilling machine. Regardless of the care which is taken in organizing a shop, the handling of large pieces with a crane is sure to cause a certain amount of commotion, which means lost production from men and machines all through the department where such work is being handled.

* * *

THE EDUCATION OF WOUNDED SOLDIERS FOR INDUSTRIAL WORK

Congress has delegated to the Federal Board for Vocational Education the task of training and educating wounded soldiers and sailors who may, in that way, be made self-supporting and useful in the industries. Available statistics show that the number of wounded soldiers who can be trained and educated for useful occupations averages about 10,000 per each million men in the Army, per year. In other words, with the present strength of the Army and Navy, it is likely that there will be 30,000 men during the first year who will return on account of having been wounded, and who will be able to take their place in civil life after having been properly trained. The experiences of our allies indicate that over 80 per cent of the permanently disabled men can enter useful self-supporting employment if properly trained.

The training will be entirely voluntary on the part of the wounded men, but it is expected that, with the facilities placed at their disposal, most of those incapacitated in the fighting will be glad to take up an occupation that will enable them to become self-supporting in the industries. The training does not, in any way, affect the soldier's or sailor's income under the War Risk Insurance, to which he is still entitled. C. A. Prosser, director of the Federal Board for Vocational Education, Washington, D. C., is in charge of this work, and any inquiries relating to it should be directed to him. The board has just issued a bulletin entitled "Evolution of National Systems of Vocational Education for Disabled Soldiers," which is a volume of 320 pages giving a great deal of information relating to the subject.

* * *

According to the *Scientific American*, an interesting series of tests was recently made by a manufacturer to determine the effect of temperature on the strength of iron and steel. These tests showed that the greatest ultimate strength of wrought iron is found at 450 degrees F. and its greatest elastic limit at 350 degrees. The tensile strength of cast iron increases uniformly until a temperature of 400 degrees is reached, when it gradually falls. The ultimate elastic strength of steel is reached at 575 degrees F., while the elastic limit decreases continuously, though not uniformly, as the temperature rises above 60 degrees F. At 1000 degrees, the steel will sag of its own weight.

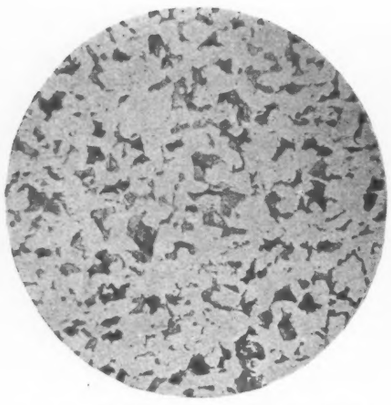


Fig. 6. Original Material—0.3 Per Cent Carbon Steel—before Welding; magnified 150 Times



Fig. 7. Original heated to 1500 Degrees F. for One-half Hour and then cooled in Air; magnified 150 Times

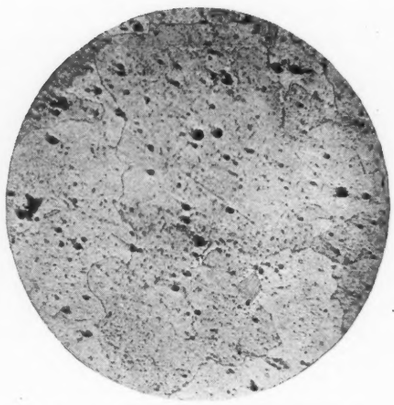


Fig. 8. Weld heated to 1500 Degrees F. for One-half Hour and then cooled in Air; magnified 150 Times

FUSION WELDING FALLACIES—2

SOME COMMON BELIEFS AND WHY THEY ARE UNSOUND

BY S. W. MILLER[1]

IN the July number of MACHINERY several of the commonly accepted, but erroneous, opinions about fusion welding were dealt with. Among other common fallacies are the ideas that a weld that is not heat-treated is suitable for any engineering structure, no matter how important; that any thermal disturbance or change in structure in or near a weld is negligible or easily corrected; that the structure of a weld can be made as good as that of the original material; that the materials used at present are entirely suitable; that a welded piece is equal to a forged piece; that welding problems can be solved by hit-or-miss methods; and that an electric weld is superior to an oxy-acetylene weld.

Non-heat-treated Welds are not Suitable for all Engineering Structures

It is a common belief that a weld that is not heat-treated is suitable for any engineering structure no matter how important. The writer's tests and experience, however, indicate that if successful and safe results are desired it is absolutely necessary to heat-treat both the weld and all metal in its vicinity. In the case of small pieces, this can be done in a crude, but effective, way with the welding torches; but for larger pieces, special furnaces or other apparatus is needed.

Where low-carbon welding wire is used to weld ordinary soft steel, there may be a difference in the temperatures required for the weld and original material of 300 degrees F., as a steel casting requires a higher refining temperature than forged steel of the same carbon content. This means a double heat-treatment; a high temperature to refine the weld, and a lower one to refine the coarsened original. The double treatment should be avoided, if possible, on account of the cost, so the welding material should have such proportions of carbon and other necessary elements as will produce a clean, sound, deoxidized weld; the material, when cast into the weld, should require the same refining temperature as the material welded, and in the refined condition, it should have the proper physical characteristics as given in the first installment of this article.

Figs. 6 to 14 show the effect of temperature on an oxy-acetylene weld and the adjacent material. The pieces were all taken from the same weld, but subjected to different treatments. The original was about 0.3 per cent carbon steel, and the welding wire was low-carbon steel wire containing about 0.08 per cent carbon. The fields in the original were taken about ½ inch from the weld. It is not claimed that the temperatures used were absolutely correct, but the tendency of the treatment is shown. Figs. 6 and 7 show the original material before welding and after being heated to 1500 degrees F. for one-half hour and then cooled in air; Fig. 8 shows that the grains were not refined in the weld. In the cases shown in Figs. 9 and 10, the steel was heated to 1600 degrees F. for one hour and then cooled in air; the grain in the original was coarsened, but the weld was not affected. By heating the steel to 1700 degrees F. for one-half hour and then cooling in air, the grain in the original, as shown in Fig. 11, was made still coarser, but the weld, as shown in Fig. 12, was refined. When the steel was heated to 1750 degrees F. for fifteen minutes, cooled, heated to 1400 degrees F. for fifteen minutes, and cooled in air, both the original and the weld were refined, as shown in Figs. 13 and 14.

Thermal Changes in Structure are not Negligible nor Easily Corrected

The belief that thermal disturbances or changes in structure in or near the weld are negligible or, if not, are easily cor-

[1]Address: Rochester Welding Works, Rochester, N. Y.



Fig. 9. Original Material heated to 1600 Degrees F. for One Hour and then cooled in Air; magnified 150 Times

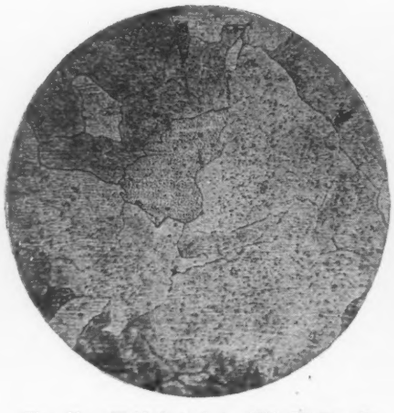


Fig. 10. Weld heated to 1600 Degrees F. for One Hour and then cooled in Air; magnified 150 Times



Fig. 11. Original Material heated to 1700 Degrees F. for One-half Hour, and then cooled in Air; magnified 150 Times

rected, is wrong. The heat of any welding process changes the structure of the original material greatly; this change extends farther from the weld in the case of oxy-acetylene welding than in the case of electric welding, and the grain growth is greater, but the zones of changed material are not so distinct. As the writer believes in properly heat-treating all welds, he does not think there is much difference in this respect between the two welding methods. There are, though, other important structural differences. The exact influence of these is not known nor, as far as the writer knows, have they been studied very much; in fact, even their nature has not been fully determined.

The coarsening of the grain reduces the ductility and resistance to shock of the metal. These conditions cannot be entirely overcome by heat-treatment, but a very great improvement can be made. Successful heat-treatment of the work requires a knowledge of the critical points of the steels used, and these points depend mostly on the carbon content. Besides, for accurate work, the proper temperatures for the proper time and the proper rates of cooling must be carefully maintained. It is not hard to get accurate results with small pieces in a small furnace, but in the case of large pieces the variations in furnace temperatures, the inaccuracies of pyrometers, and other variables materially affect the results. Still, as it is now possible to use heat-treatment methods in ways believed impossible a few years ago, the writer sees



Fig. 12. Weld heated to 1700 Degrees F. for One-half Hour, and then cooled in Air; magnified 150 Times. Note that Weld has been refined

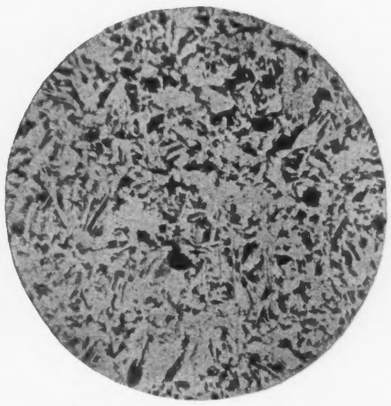


Fig. 13. Original heated to 1750 Degrees F. for 15 Minutes, cooled, and then heated to 1400 Degrees F. for 15 Minutes and cooled in Air; magnified 150 Times

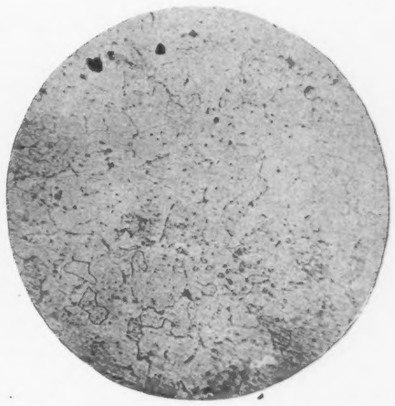


Fig. 14. Weld heated to 1750 Degrees F. for 15 Minutes, cooled, and then heated to 1400 Degrees F. for 15 Minutes and cooled in Air; magnified 150 Times

no reason why such work could not be carried out on large pieces, tanks for example, even when viewed from a commercial standpoint. At first a factor of 50 per cent, for instance, of the plate strength might be all that would be safe, but certainly the welding industry would not be satisfied with that result and, as in all similar cases, improvement would be certain.

The Structure of a Weld Cannot be Made as Good as that of the Original Material

It is commonly stated that the structure of a weld can be made as good as that of the original material. This, however, cannot be done, for the finest grain, and therefore the best physical qualities, can only be obtained by using both heat-treatment and forging, or other mechanical treatment. As forging cannot be done in most welds it is evident that the best results cannot be secured. The most that can be expected is what can be obtained in a properly heat-treated steel casting, and this is not equal to a heat-treated forging.

Material now Used is not Entirely Suitable

Contrary to the general belief, all material now used for welding is not entirely suitable. Much of it is likely to carry impurities into the weld so that good results can be obtained only when great care is used. However, suitable materials for all purposes will, no doubt, eventually be found.

A Welded Piece is not Equal to a Forged Piece

A customer frequently asks if a piece of forged steel will be as good after it has been welded as it was before; and he is assured by the welder that it will be. While the welder may be honest in his belief, the piece will not be as good, for a weld is a steel casting and therefore must be inferior to a forged piece even though it is heat-treated. A weld in alloy steel is even poorer and less satisfactory than one in straight carbon steel.

Welding Problems Cannot be Solved by Hit-or-miss Methods

The writer has many times stated his belief that, because of the tremendous commercial development of the welding industry, the scientific problems involved have not received the attention they deserve and require. Steel manufacture is carried out under the guidance of chemical and physical laboratories; if this had not been so the great improvement during recent years in the quality of steel would have been impossible. Making a good weld is nothing but making a good casting, and it should therefore be controlled by the laboratory. For this reason, welding problems cannot be solved by a hit-or-miss method of trial and error. This matter is purely a metallurgical one, although there are many practical problems that must be solved in the shop. The basis of all welding is the production of a sound weld of desirable physical qualities.

An Electric Weld is not Superior to an Oxy-acetylene Weld

Although the writer does not think that an electric weld is superior in quality to an oxy-acetylene weld, he willingly admits that in many cases electric arc welding may preferably be used. Neither does he think that it is impossible to improve the quality of the welds, for he knows that it is. Electric welding has four disadvantages: It is impossible to see clearly what is going on during the operation; all material in the pencil must go into the weld; it is impossible to go back over the weld to correct any imperfections that may exist; there is an enormous amount of oxide in this weld. The first of these disadvantages is probably insurmountable, if due regard is given to the safety of the operator's eyes; but scientific study may overcome it to some extent. The second disadvantage may be overcome by the production of a specially clean wire. The third is a very unsatisfactory condition and probably cannot be entirely overcome, although skillful operation tends to eliminate imperfections. The fourth may be overcome by the use of a welding wire of such composition as will eliminate the oxide. Figs. 15 and 16 show the relative amounts of oxide in oxy-acetylene and electric welds made with low-carbon steel wire; the magnification in each case is 320 diameters.

The writer, personally, has never seen a perfectly sound electric weld, and he knows electric welds can be improved because some are better than others. As a matter of fact, both oxy-acetylene and electric welding practices need careful revision if they are to have the confidence of responsible engineers. The unanimous opinion of engineers is that in the present state of the art, while some good welds are made, there is such a serious lack of uniformity in the quality of the work as to throw suspicion on all welding. They, therefore, refuse to use it, for example, in boiler construction, where theoretically its uses would be of great benefit. These im-

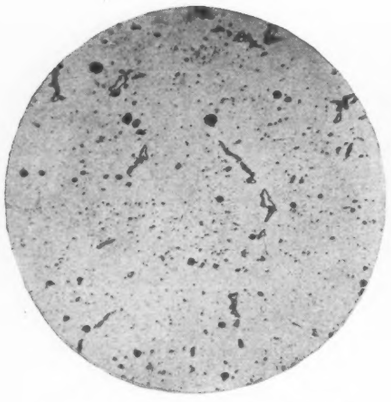


Fig. 15. Oxy-acetylene Weld, showing Oxide as Black Specks; magnified 320 Times



Fig. 16. Electric Weld, showing Oxide as Black Specks; magnified 320 Times

provements will have to be made with the greatest rapidity possible, and work incompatible with the fundamental principles of metallurgy must not be done. No welding operation must be performed unless there is an absolute assurance of safety in the result, where life is involved. It will not do to say that because the percentage of accidents that have occurred is very small, and smaller than occurs with other methods of joining, the present methods of welding are good enough. Such an argument was used in connection with industrial injuries; but the safety-first campaign has proved that accidents which were at one time considered unavoidable can be prevented if proper means are taken. It has also proved that the adoption of such preventive measures has more than paid all the expense connected with their introduction. In the same way the adoption of the best possible welding methods and the restriction of such methods to proper applications will result in a great increase in the amount of welding, and in the long run will be much less expensive than following the present methods.

* * *

BELT-SHIFTING APPLIANCE

In the installation of textile machines where the product passes directly from one machine to another in an unbroken condition, it is necessary that some provision be made for stopping and starting the machines in unison from several different positions. As the distance between the extreme positions at which it is desired to locate the belt-shifting controls is often 50 or 60 feet, it requires a shifting appliance of unusual strength and mechanical design.

The following method was used to provide the necessary stopping and starting control for three textile machines *M*, *N*, and *O*, arranged as shown in Fig. 1. As it is necessary that frequent adjustments be made at the positions opposite the points *S*, it was desired that stopping and starting could be accomplished at these positions. As will be seen in the illustration, all three machines are belt-driven from pulleys on shaft *F* which, in turn, is driven by a 5-inch belt connecting flat-face driving pulley *G* with tight pulley *H*. Shaft *F* is stopped by shifting belt *I* from tight pulley *H* to loose pulley *J*. The one-inch shaft *K* is suspended from the ceiling by bearings *L*. Cast-iron pulleys, about 10 inches in diameter, are keyed to the shaft at the points *S* as shown. On these pulleys is a section of belt provided with rods of the shape shown at *W*, the length of which is such that the handles are at a convenient height from the floor. The belt *T* is held to the face of the pulley by a stud *U*. Now it will be seen that by a downward pull on the rod at the right-hand side of the pulley the shaft can be rotated through one-half revolution. At point *P* on shaft *K* is a sprocket connected by a link chain with the sprocket *C* on the shifting device shown in Fig. 2.

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F. C. D.

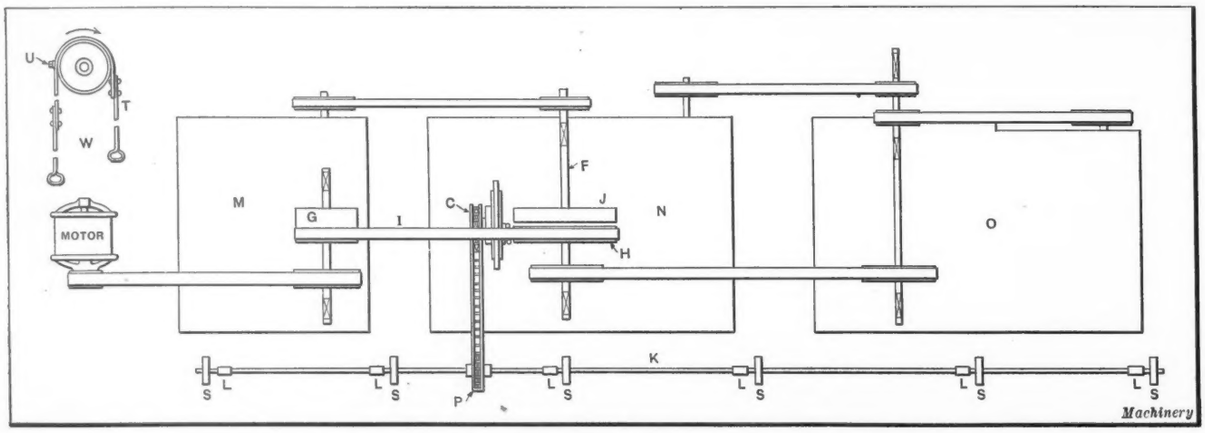


Fig. 1. Arrangement of Belt-shifting Mechanism for Three Textile Machines

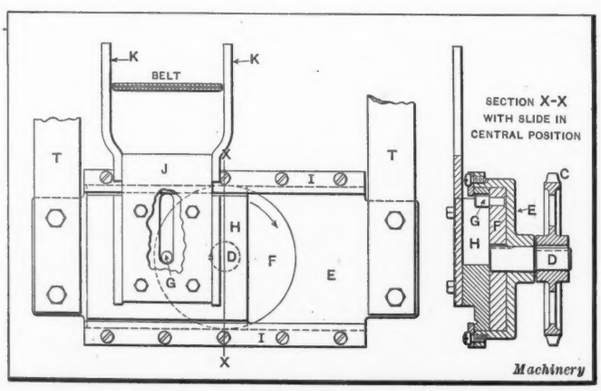


Fig. 2. Details of Belt-shifting Appliance

CHARTS GIVING TIME REQUIRED TO HOB SPUR GEARS

BY V. P. RUMELY [1]

Many factors affect the production of gear-hobbing machines. Among these are the condition of the machine, the work supports, the condition of the hob, the nature of the material, the cutting compound, the finish of the gear, and the type of hob used. The bearings of the machine must be in good adjustment, the change-gears free from excessive backlash, and the hob carriage well adjusted on its ways. The work supports should be of the most rigid type possible to guard against chatter. The hob should have the proper temper and sharpness. The cutting qualities of the material are affected by alloy compositions, heat-treatment, hard spots, seams, and sand-holes. The value of the cutting compound depends on its quality as a coolant and lubricant, and the amount furnished at the vital places on the hob. The finish of the gear depends on whether the hob has a gashing or a finishing cut. The hob may have a single, double, or triple lead.

[1]Address: 589 Navahoe Ave., Detroit, Mich.

The greatest possibilities lie in gashing such work as transmission and timing gears where the hob can be forced close to the limit all the time, with little regard for the resulting finish. The recent practice in this line of hobbing tends toward triple-lead and double-lead hobs, with three streams of cutting compound applied to the hob. There are three to five shifts of the hob between grindings, and the hobs are ground at least once every eight hours. One firm has determined that the economical life of a hob is from fifteen to twenty-two days, running two shifts per day. The time required for hobbing a gear may be determined by any one of the following methods: By estimation, relying upon experience on similar jobs; by calculation, which is confusing to the novice and cumbersome for many mechanics; and by a graphic method, such as is illustrated by the accompanying charts. When using these charts the cutting speed and feed are first selected. The cutting time is found for the entire load upon the arbor, and this is divided by the number of gears to find the cutting time for each gear. It is necessary for the hob to travel a distance equal to the total width of the gear face plus the over-travel *X*, Fig. 1, due to striking the gear blank some distance in advance of the hob

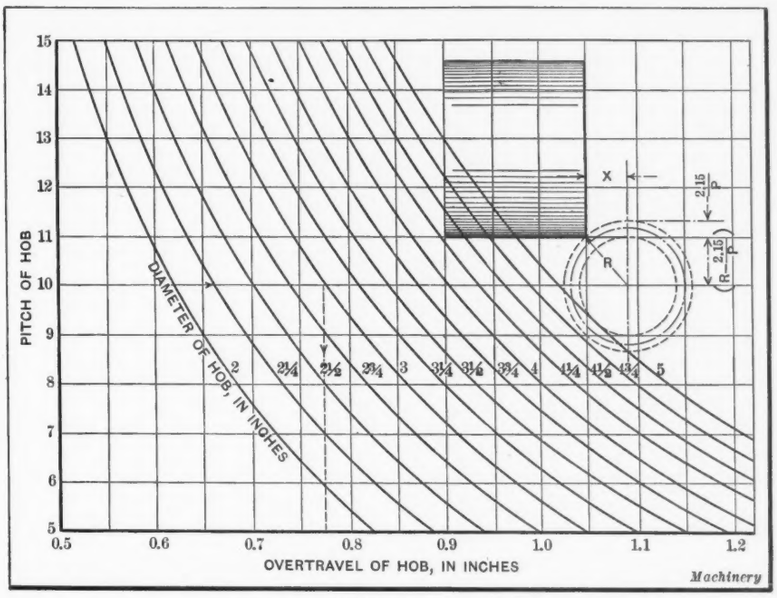


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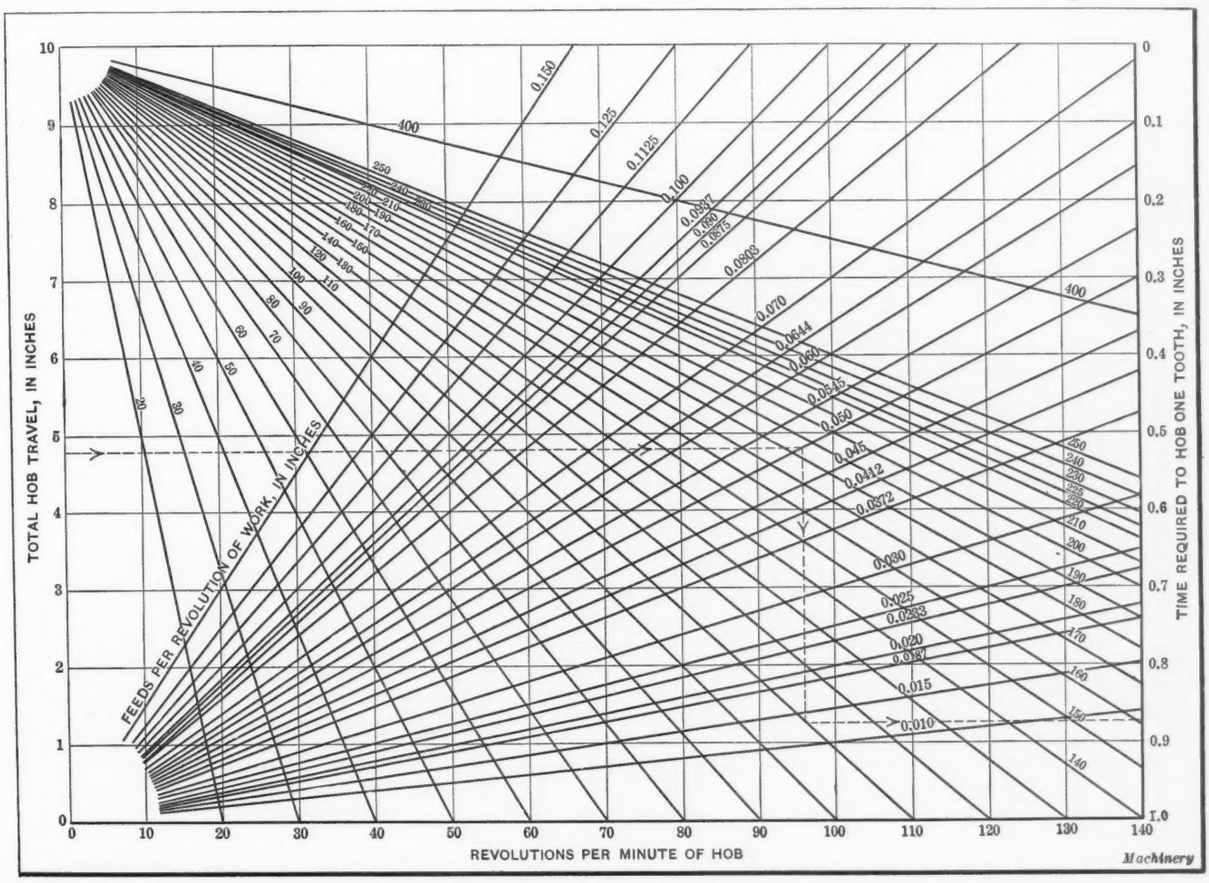


Fig. 2. Chart giving Cutting Time of One Tooth

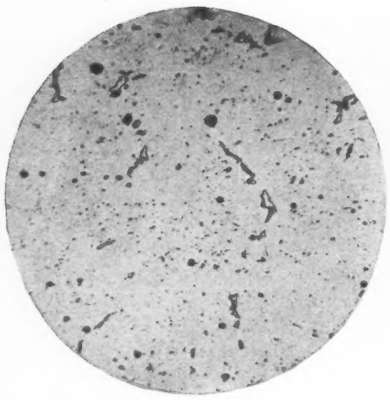


Fig. 15. Oxy-acetylene Weld, showing Oxide as Black Specks; magnified 320 Times

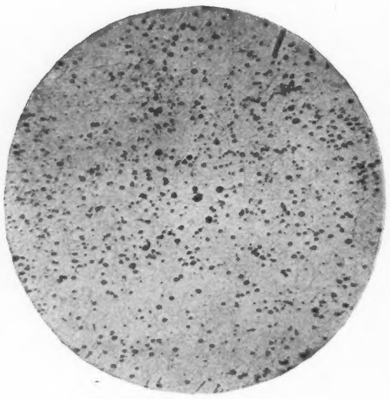


Fig. 16. Electric Weld, showing Oxide as Black Specks; magnified 320 Times

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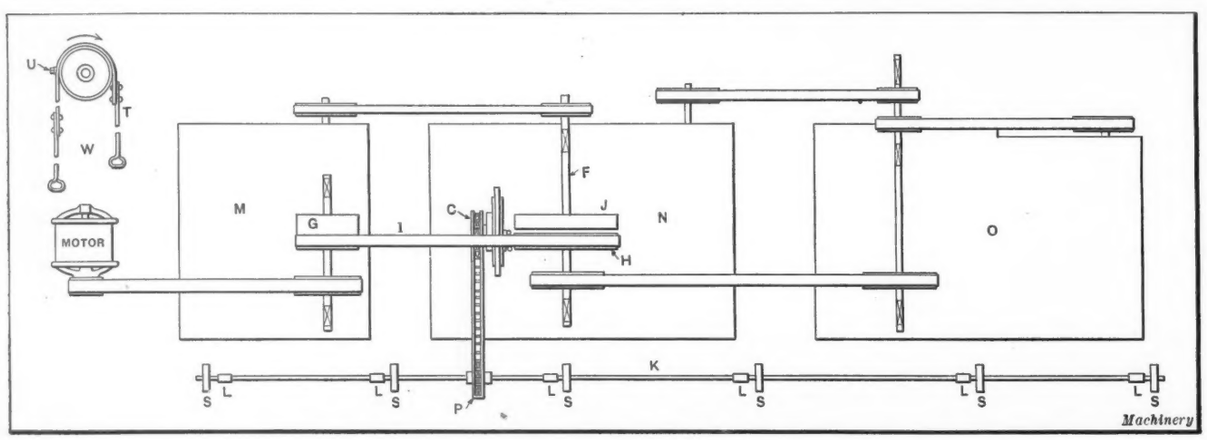


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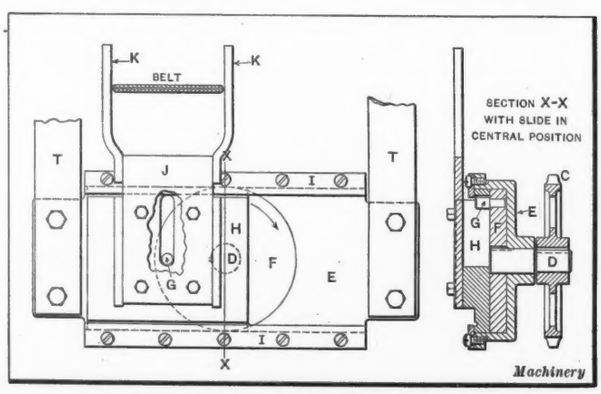


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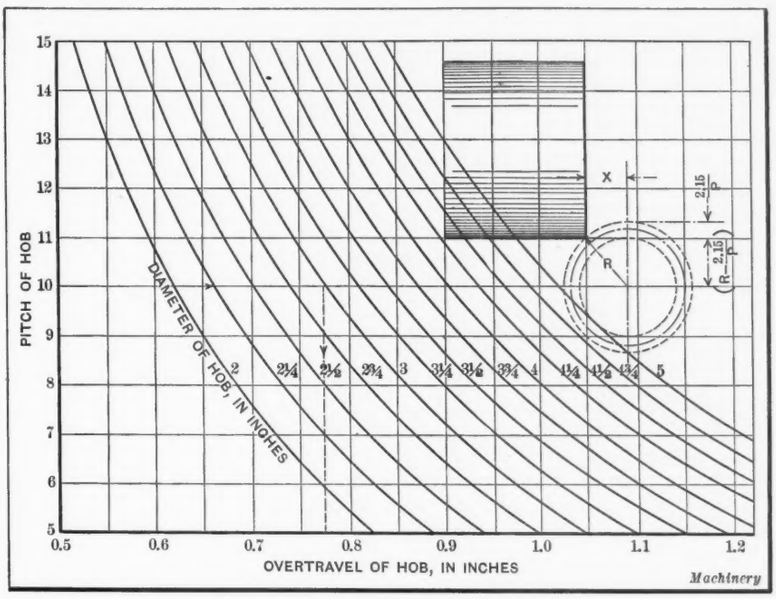


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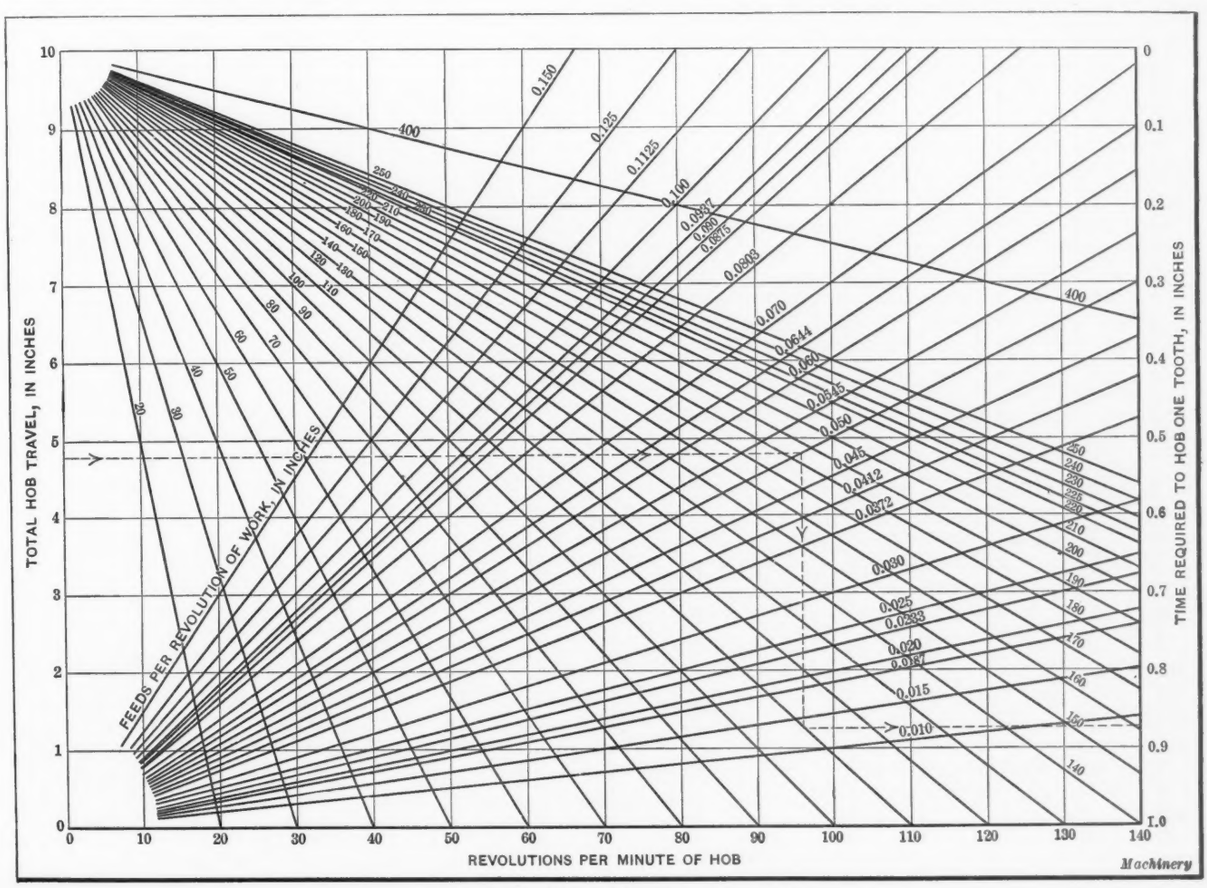


Fig. 2. Chart giving Cutting Time of One Tooth

center. This over-travel varies according to the diameter and pitch of the hob and may be calculated by the formula:

$$X = \sqrt{R^2 - \left(R - \frac{2.15}{P}\right)^2}$$

This value may be found directly by referring to Fig. 1. Add to this the total width of the gear face, in inches, and locate this sum in Fig. 2 in the column indicating the total hob travel. From this position, move horizontally to the right to the intersection with a diagonal feed line equivalent to the chosen feed, and move vertically, up or down as may be necessary, to the intersection with a diagonal line representing revolutions per minute of hob. Then move horizontally to the right-hand column and read in minutes the exact cutting time of one tooth of the load. Multiply this value by the number of teeth in one gear; this gives the total cutting time. If the load consists of a number of gears, divide the cutting time found by this number. If a double- or triple-lead hob is used, the cutting time will be one-half or one-third, respectively, of this value.

Example—What is the cutting time of one gear having 30 teeth, 10 diametral pitch, if four blanks 1 inch wide are placed on the arbor? The teeth are cut by a triple-lead hob 3 inches in diameter, running at 110 revolutions per minute and the feed of the work is 0.05 inch per revolution of the work. By using the chart in Fig. 1, the over-travel is found to be 0.775 inch. Add this to 4, the face width of the gear blanks, and the total hob travel will be 4.775 inches. In Fig. 2, find the value 4.775 inches in the left-hand column and move horizontally to the right to the intersection with the 0.05 inch feed line; then move vertically to the intersection with the line showing 110 revolutions per minute; by moving horizontally to the intersection with the right-hand column, the cutting time of one tooth will be found to be 0.87 minute. Multiply this value by the number of teeth and divide by the number of threads of the hob; $\frac{0.87 \times 30}{3} = 8.7$ minutes, cutting time of four gears; $8.7 \div 4 = 2.175$ minutes, cutting time of one gear.

* * *

APPRENTICE DEPARTMENT OF THE AMERICAN LOCOMOTIVE CO.[1]

BY C. K. GETCHELL

The apprenticeship courses of the American Locomotive Co. provide an opportunity for young men to learn a trade or profession while earning their own living, either in the drawing-room or in the shops, at work which is actually used in the design or construction of locomotives. There are several different branches in which an apprentice may specialize. These include the following: drafting; machine operation, including toolmaking and die-sinking; patternmaking; coremaking; molding; boilermaking; carpentry; printing; and electrical maintenance.

Drafting-room Apprenticeship

Applicants for the course in drafting should be between sixteen and nineteen years of age; in special cases young men slightly older have been taken. Previous education required includes one year of high school and at least one term of algebra. A preliminary examination is given, covering elementary mathematics, sketching and several problems of a mechanical nature. No grade is given, the general aptitude for work along the line of machine design being the basis for acceptance or rejection. Apprentices are taken on trial for a month.

The course is planned to cover four years. There are forty-four working hours each week, of which three are spent in the school-room. The course covers machine design, based upon actual practice in designing locomotives, and certain problems relating thereto are assigned for each week's study. Frequent reference is made to existing designs and drawings, and there are several problems which require measurements of parts under construction in the shops, with calculations showing how their dimensions were determined. Completion of these problems in the scheduled time is estimated to require about eight hours of study outside of the time spent in school.

No regular classes are held, each apprentice having an opportunity for such personal instruction as he may require during his class hour. In this way he is not held back to accommodate others who may be slower in their work, and his progress depends entirely upon himself. Apprentices have frequently been able, on this account, to complete the course in less than four years. The pay is based upon the amount of work completed and the standing or grade attained. Grades are determined as follows:

A Grade .....85 per cent and over
B Grade .....70 per cent to 85 per cent
C Grade (or base) .....Below 70 per cent

Those apprentices who attain a rating of B grade receive two cents more per hour than the base rate, and those who attain A grade receive three cents more per hour. The base rate is advanced at the completion of each six months' assignment of problems and is independent of the time spent on the course. Credit is also given for over-time and occasionally for previous experience when warranted by the proficiency shown. Two weeks' vacation is also allowed each year, and it is desired that these be taken for rest rather than as an occasion for extra study. Opportunity is provided for evening study in the general drawing-room, where access may be had to the company's standards, which are frequently referred to in the studies. Provision is made for the transfer of each apprentice from one section of the general drawing-room to another, affording an opportunity for him to familiarize himself not only with detail design, but also with general assembly or elevation drawings. Grouped according to the progress made in their work, the apprentices make an hour's visit each month to the shops and take notes, which are later discussed in class.

While the majority of drawing-room apprentices are at the Schenectady works, there are several at the other plants who have the same problems, receiving instruction by mail, and who obtain such personal assistance as they require from the chief draftsman at those plants.

Shop Apprentice Courses

Applicants for the shop apprentice courses should be between the ages of sixteen and nineteen, and while one year's high school education is desirable, it is not absolutely required. All these courses require four years, except that in electrical maintenance, which requires only three. There are fifty working hours each week, except in the coremaking and molding trades, which require forty-five hours. Class hours include one and one-half hour per week for the machine and patternmaking trades, one hour of this on the company's time and the half hour on the apprentice's own time. Instruction is given in shop mathematics, together with such shop principles as apply to the different trades, and particular attention is given to blueprint reading. Frequent trips to the various shops afford an opportunity for each apprentice to learn how the work he is doing is used in the final construction of locomotives. In this way he is able to become more interested and to work more effectively. Transfer of machinist apprentices from one shop to another affords chances for them to learn the manipulation of the several types of machines.

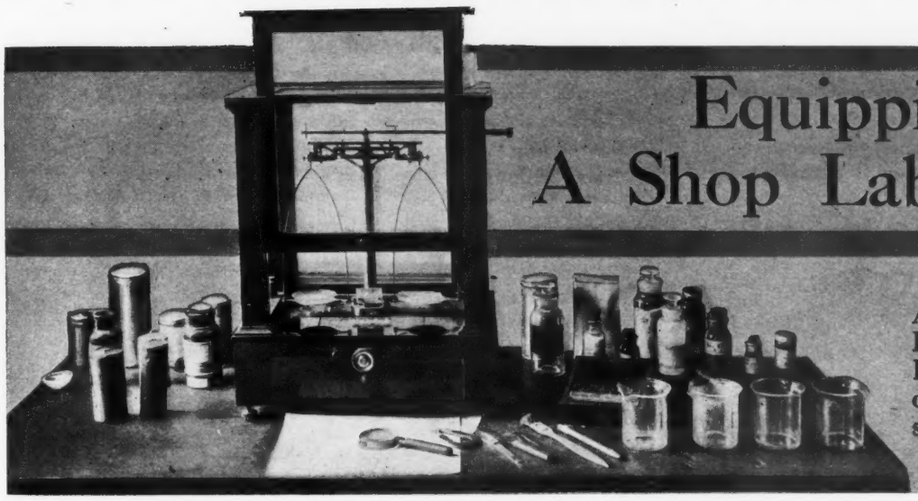
Graduate Apprentices

Upon the completion of each course the apprentice receives a certificate and is given an increase in pay, with such an opportunity for further advancement as his ability warrants. In addition to this, the drawing-room graduate receives a substantial cash bonus. Although, like many other industries, this company has lost a number of men on account of the war, there are still about 35 per cent of our graduate apprentices in the general drawing-room and about 45 per cent in the various shops, many of whom are holding responsible positions.

* * *

According to the *Arizona State Safety News*, industrial accidents cost this country 35,000 lives annually. In addition, there are 350,000 dismemberments and other serious injuries, and over 2,000,000 minor accidents that cause a loss of time.

[1]Abstract of an article published in "Loco," May, 1918.



Equipping A Shop Laboratory

Arrangement of Shop Laboratory and Brief Explanation of Methods Used in the Analysis of Iron and Steel

BUILDERS of machinery and manufacturers of tools are undoubtedly desirous of having a full knowledge of the chemical ingredients of the raw material which they buy and use in their product, and of being assured that these ingredients conform to recognized standards and specifications, within practical limitations. Hence, it is rather surprising to note the large percentage of metal-working shops in this country that are without the proper facilities for ascertaining these chemical elements—the more so as this need was felt and many years ago met by European manufacturers through the installation of chemical laboratories in their plants, which have adequate (although not necessarily expensive) facilities for handling routine analytical work. Many a manager will claim that he does not buy enough raw material and that he does not have trouble enough with it to warrant incurring the expense of a laboratory. However, in times of close competition, when his product does not always measure up to that of his competitor, he will generally find after a close study of the cause of his trouble that, outside of poor workmanship, the fault can usually be traced to the use of poor or improper raw materials.

Which Customer Gets the Poor Raw Material?

Furthermore, he should not forget that the steel mills occasionally produce inferior products that will have to be disposed of somehow; and it is certain that the customer who is known to have a laboratory for testing his raw materials will not receive any of the inferior steel. It may be claimed that there is not enough raw material to be tested to warrant the expense of a laboratory and that it is a better plan to send the few specimens that must be tested to a professional chemist. This is not only very costly (at least fifty cents per element), but it will also cause serious delays, as the chemist does not work for only one client; each one will have to wait his turn. The most serious consideration, however, is the delay that is caused. Often, when raw material is received by a manufacturer, it has been waited for so long, and customers are so urgent for delivery, that the material has to be used immediately, making it impossible to wait for a report from an outside chemist. It should also be remembered that the proper time for making an analysis is before the material has been made into parts—not after trouble has developed.

Cost of Equipping Laboratory

Considering the preceding facts from all standpoints, readers of MACHINERY will readily concede that a chemical laboratory is quite necessary, not only for large manufacturing establishments, but also for small shops, as the cost of equipping it is comparatively small (about $400 or $500 even at present advanced rates). The most suitable place for a laboratory is the basement of a building, for the reason that the room should first of all be free from vibration, which, it will be readily understood, may seriously affect the use of the chemical weighing balance and the other extremely sensitive apparatus used by the chemist. The room should preferably be sheathed with wood so that no trouble will be experienced from particles of plaster or whitewash falling into evaporating dishes and other apparatus with which the chemist is working. In weighing out materials used in chemical analysis, all weights are taken to 0.0001 gram, from which it will be seen that the addition of even a minute particle of whitewash would cause a serious error. The laboratory benches should be well built and made of well-seasoned wood, and their tops should be covered with acid-proof asbestos, to prevent the hot evaporating dishes, etc., from sticking and to protect the woodwork against the action of acid that may be spilled. If the above suggestion is followed, the benches will always be neat and clean.

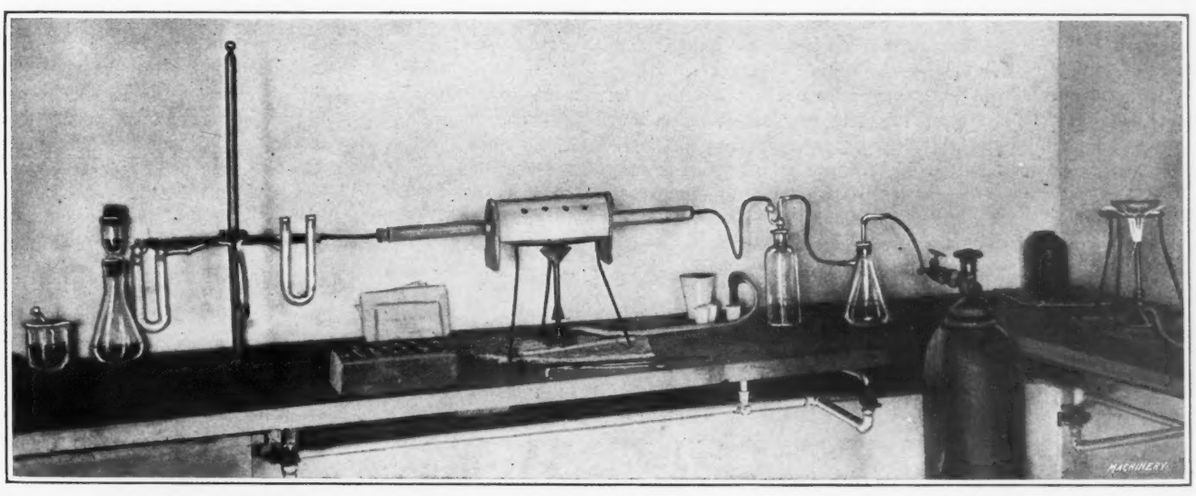


Fig. 1. Arrangement of "Carbon Train" which is employed for determining Percentage of Carbon in a Steel by Combustion Method

Lay-out of Shop Laboratory

Although not absolutely necessary, it is desirable to divide the laboratory into two parts—the laboratory proper and the balance room. If this is not feasible, the balance should be placed on a bench fastened only to the wall of the building. This will prevent any jars or vibrations, except those caused by the building itself, from being transmitted to the balance while it is in use. An arrangement of this kind will be found absolutely necessary, if, for some reason, the laboratory must be located on any of the upper floors of the building. A convenient arrangement for a laboratory is shown in Fig. 2. It will be seen that the store-room and balance room have been combined so that supplies may be kept outside the laboratory proper, which should be not smaller than 20 by 10 feet. It should have a bench on one, if not both, of the longer sides and should also contain an earthenware sink with a draining board, gas stove, still (all water used in chemical analysis must be distilled), iron slab, and two draft hoods. The latter consist of two adjoining compartments, about 2 by 6 feet in size, built out from the wall with ventilating shafts running to the outside. Windows should be provided in the front which can be easily opened and closed. In this manner, a good draft is provided to carry off the noxious fumes. Eight or nine shelves should be placed on the wall to hold reagent bottles

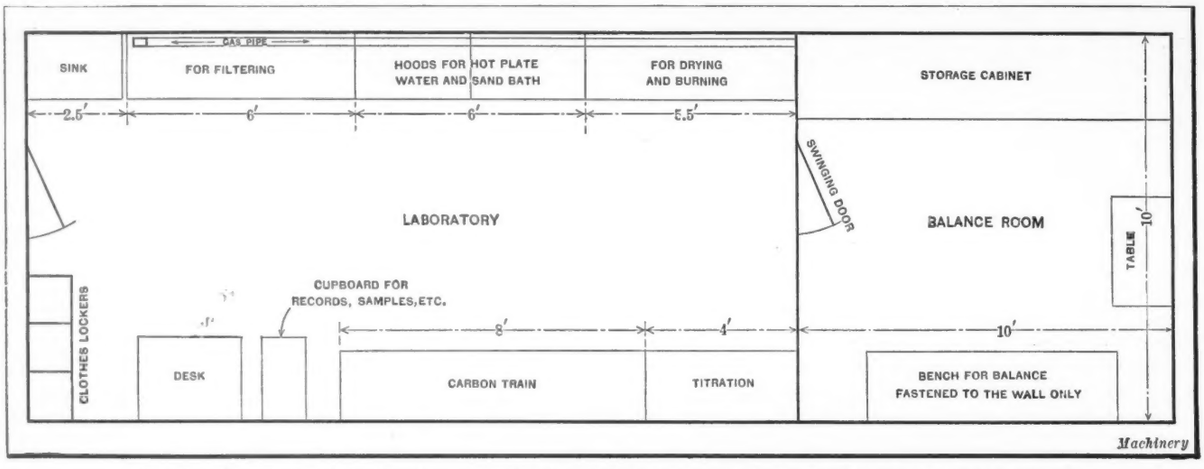


Fig. 2. Floor Plan of Shop Laboratory. Attention is called to Location of Filtering Bench next to Sink and Drying and Burning Bench next to Balance Room

and a few drawers should be provided to hold the glass tubing, cork and rubber stoppers, etc. When not in use, such apparatus as glass beakers, flasks, evaporating dishes, etc., should be stored in a closet.

All the measurements used in iron and steel analysis (and in practically all laboratory work) are expressed in the metric system; therefore, it is absolutely necessary for the chemist to know the tables of weights and measures and to be able to think in terms of the metric system. One reason for using this system is that it is very easy to change from units of volume to weight and vice versa.

The analysis of iron and steel may be divided into two parts—the determination of the different constituents that are present in the material, which is called "qualitative analysis"; and the determination of the proportion or percentage of each of these different constituents which is called "quantitative analysis." Qualitative analysis is of no real practical value for iron and steel, because it does not give the actual percentages of different constituents, and takes just as much time as quantitative analysis.

Methods of Taking Sample for Analysis

It is absolutely important that the sample of steel or iron to be analyzed should represent all the impurities, etc., that are present in the metal. As some metals vary in the composition of impurities, it is necessary to take a sample from the different parts of the specimen. Extreme care must be taken to see that the chips that are to be analyzed are absolutely free from oil, grease, water, etc. Turnings or drillings must be produced dry—without lubricant or cutting compound of any kind being used. This has led many to use filings as suitable chips for analysis, but the practice is dangerous, as some of the file teeth may break off and become mixed with the steel chips, which may make the whole analysis inaccurate. The man who takes the sample should always bear the importance of his work in mind. If the sample used by the chemist is not representative of the material as a whole, the analysis cannot possibly give reliable information. When it is possible, the chemist should always take his own sample for analysis.

Enough chips (about two ounces or 55 grams) should always be made so that there will be at least an equal quantity left to make a check analysis or test. These should be placed in small boxes or envelopes with a number, which is entered in a record book or card index that should give the history of the metal. The method of sampling steel adopted by the Society of Automotive Engineers is as follows:

1. Wire, tubing, sheets, and rods less than 1¼ inch in diameter or thickness should be sampled across the entire section.

2. Forgings or pieces of irregular shape should be sampled by drilling or cutting at the thickest and thinnest sections or lengthwise and across the entire section.

3. Bars and billets or other shapes above 1¼ inch should be drilled at a half radius, that is, half way between the center and the exterior surface.

Constituents of Iron and Steel that are Determined by Analysis

For the purpose of quantitative analysis, steel may be classified as carbon steel, low-carbon alloy steel, and high-speed steel. These classes are distinguished, in a great degree, by the particular elements included in their composition and by their after treatment. A change in the composition of a steel usually means a corresponding change in its properties. For instance, the addition of certain metallic elements to a carbon steel causes a change in the hardening temperature. Therefore, it is important to know the constituents of the steel, the quantity of each constituent that is present, and the influence of each. It has been explained that qualitative analysis determines what constitutes are present in a substance and quantitative analysis, the quantity of each constituent. Practically all steels contain carbon, silicon, manganese, sulphur, and phosphorus, the silicon and manganese being added to the steel when it is poured from the furnace in which the refining process is conducted; although attention is called to the fact that basic steel in most cases is free from silicon. The determination of these elements in carbon steel constitutes a complete analysis. In the case of a chromium steel, the percentage of chromium must be determined, in addition to the other elements; and in the case of a vanadium steel, the amount of vanadium, etc., must be found. In addition to carbon, manganese, silicon, sulphur, and phosphorus, high-speed steel should also be analyzed for tungsten,

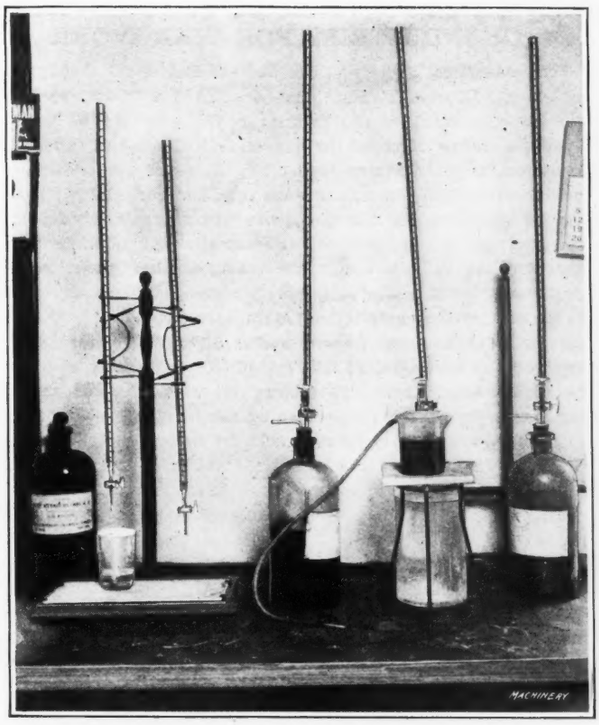


Fig. 3. Burettes set up for Use in determining Amount of Phosphorus, Manganese, Chromium, and Vanadium by Titration

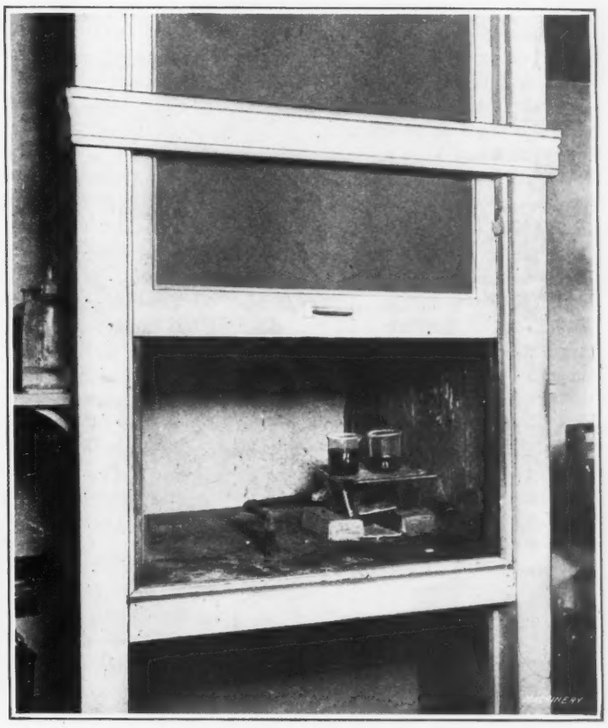


Fig. 4. Draft Hood arranged to carry off Noxious Chemical Fumes given off during Evaporation of Solution, etc.

chromium, vanadium, and, in the case of some high-speed steels, nickel and molybdenum.

Gravimetric and Volumetric Analysis

There are two methods of quantitative analysis, both of which are in quite general use. These are known as "gravimetric" and "volumetric" analysis. A sample weighing exactly 1.0000 gram is usually weighed out in making an analysis because of the ease with which the results of the analysis of such a sample can be converted into percentages. It should be noted, however, that for the analysis of silicon and sulphur, one gram is not quite enough to obtain accurate results, and for phosphorus (gravimetric) 1.63 gram is used (then one milligram of the weight = 0.001 per cent phosphorus). As the name implies, gravimetric analysis consists of determining the percentage of a constituent, say carbon, in the sample of iron or steel which is to be analyzed by first accurately weighing out a sample and then treating it chemically, so that the steel is dissolved and the constituent that is to be determined is converted into an insoluble chemical compound (called a "precipitate") which can be filtered out of the solution, dried, and weighed. This compound has a definite composition, and with a knowledge of this composition and the weight of the compound, the weight of the required constituent of the steel may be calculated and hence the percentage of that constituent present in the original sample of the steel. The precipitate is filtered through a porous paper held in a funnel and after filtration has been completed, the filter paper and precipitate are dried and the filter paper burned in a weighed crucible. The crucible and precipitate are then weighed and the weight of the precipitate is found by deducting the weight of the empty crucible. In volumetric analysis, a sample is weighed in the same way as for gravimetric analysis. It is then dissolved in acid, and after receiving suitable chemical treatment is subjected to an operation known as "titration." This is done by adding to the steel in solution a chemical solution which will react with the chemical compound into which the required constituent of the steel has been converted. The solution used for titration is contained in a measuring vessel known as a "burette"

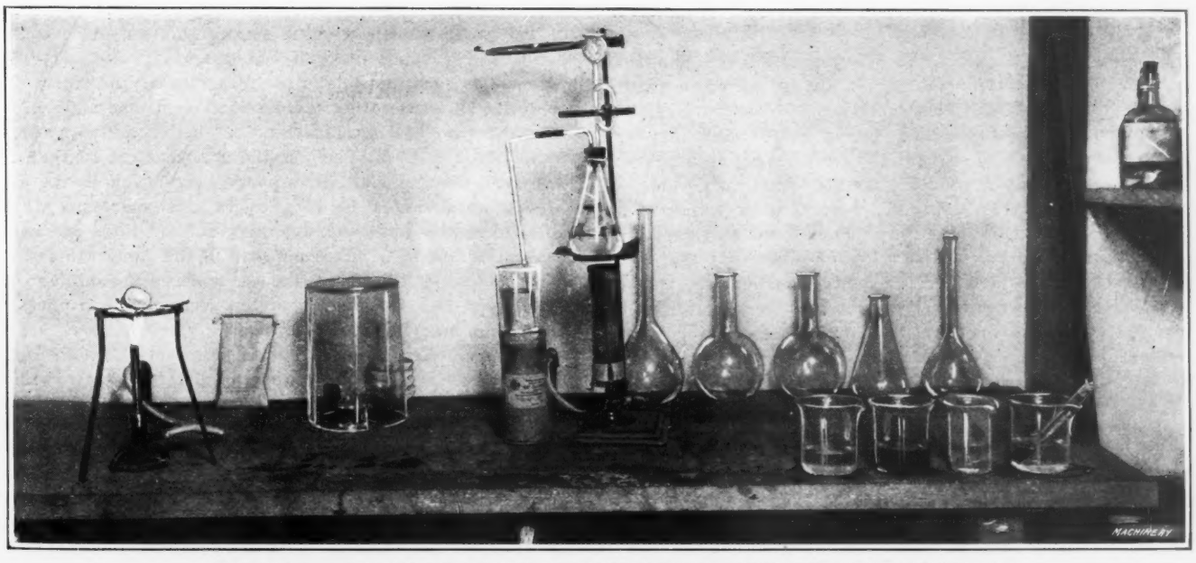


Fig. 5. Arrangement of Apparatus used by Chemist for igniting Precipitates, Evaporating Solutions, etc.

(see Fig. 3) which is graduated to show the number of cubic centimeters of the solution that are used for titration. The solution is of known strength so that each cubic centimeter corresponds to a certain fraction of a per cent of the constituent (say manganese) which is to be determined in making the analysis of the steel.

In conducting any form of chemical analysis, it is necessary to perform a certain number of operations, such as weighing, drying, evaporating, and precipitating, the latter being the name given to the process of treating a solution chemically so that an insoluble compound is formed which may be isolated by filtering it out of the liquid. Great care must be taken in the performance of all these operations to avoid making any mistakes in weighing out the sample taken for analysis or losing even a minute part of the original sample or the compounds into which the sample has been converted through treatment with suitable chemical reagents. All weighing must be done very carefully, and in order to do this it is important to have the pans of the chemical balance perfectly clean and in proper adjustment. The chemist ordinarily weighs to 0.0001 gram, so that a few grains of dust on one of the balance pans would vitally affect the accuracy of the result.

Colorimetric Analysis

Of all the methods used in making a quantitative analysis, there is probably none that is more unreliable than the colorimetric method, which consists of comparing the color of a solution containing the unknown sample to be analyzed with that of a solution containing a sample of known composition. This method is sometimes used to ascertain the percentage of carbon in steel. The sample is dissolved and, after suitable chemical treatment, it is placed in a glass tube beside a tube containing a similarly prepared solution of a steel containing a known percentage of carbon. These two tubes are placed in a colorimeter where they can be viewed by transmitted light through a frosted glass. The solutions are a light straw color, and from the relative intensity of color of the two solutions, the amount of carbon in the steel that is being analyzed can be ascertained. The colorimetric method is almost sure to be unreliable when used by other than thoroughly experienced chemists, and it is not at all unusual for this method to give results that are from 10 to 50 per cent wrong when a man of moderate experience attempts to make determinations in this way. The colorimetric method is never used for a final or checking test, and its findings are never recognized in an argument or controversy by anyone with a sound knowledge of the principles of chemical analysis. Hence, this method is one that should be avoided in deciding upon the ways in which work is to be conducted in a laboratory that is installed for the purpose of analyzing steel and iron in shops engaged in building machine tools or manufacturing cutting tools.

Methods of the Bureau of Standards

The Bureau of Standards in Washington, D. C., publishes methods for determining the percentage of various constituents in iron and steel. These methods are certainly capable of producing accurate results, but in some cases they are unnecessarily slow, and it requires such a long time to make a determination as to render the method practically valueless for use in laboratories doing commercial work where "time is money." The chemist in the average shop laboratory will usually find it more desirable to employ methods that have been developed by industrial chemists who have had plenty of experience in learning the requirements of analytical work done for manufacturing establishments. These methods give perfectly reliable results and can be completed in practically the minimum time required for making the analysis.

* * *

The U. S. Employment Service reports that the campaign for enrollment of the "public service reserve" of workers cost about $25,000. As 315,000 men were enrolled and 13,000 were placed, the cost per worker enrolled was 8 cents, and the cost per worker placed $1.77.

A. S. M. E. COMMITTEE FOR READJUSTMENT OF INDUSTRIES FOR WAR WORK

The American Society of Mechanical Engineers through its president, Charles T. Main, has appointed a "Committee for the Readjustment of the Industries for War Work" with a view to aiding directly in the placing of all the industrial resources of the country—especially those in the mechanical engineering field—in touch with one another and with the proper governmental bureaus, so as to make it possible for all of them to use their facilities to the best advantage for the winning of the war. The work of the committee, at first, would be to list names of manufacturers, especially those of small capacity, that are able to perform some kind of war work and who have found it difficult to obtain direct government contracts. These manufacturers would be placed in touch with larger contractors or with the government bureaus with a view to furnishing them with such work as is necessary at the present time. In this way, it is hoped that the facilities of non-essential industries may be more than ever mobilized for essential war manufacture.

The American Society of Mechanical Engineers has undertaken this work, because it is believed that the mechanical engineers of the United States are more closely in touch with the manufacturing facilities than any other organization, and with the cooperation of the membership of the society it is expected that the work planned for can be carried out in an effective manner. Representatives of the society have been appointed in various districts corresponding to those into which the country is divided by the War Industries Board with regard to munitions manufacture.

The committee appointed by the society for carrying on this work consists of George Kingdon Parsons, president, G. K. Parsons Corporation, 29 Pine St., New York City, who is the chairman; Frederick A. Scheffler, sales engineer, Babcock & Wilcox Co., 85 Liberty St., New York City; and Erik Oberg, editor of MACHINERY, 148 Lafayette St., New York City. The duties of the committee will be to direct all of the society's work along the lines of the readjustment of the industries for war work and to assist in discovering the proper means for cooperating in the several regions with the United States Chamber of Commerce and the War Industries Board or other governmental agencies, as well as to arrange for the selection of specialists for certain phases of the work. One of these specialties has already been partially cared for through the activities of the Machine Shop Committee of the American Society of Mechanical Engineers of which Ralph E. Flanders, manager of the Jones & Lamson Machine Co., Windsor, Vt., is chairman. This committee will handle the conservation and production of heavy machine tools for Ordnance work.

It is believed that this step of the American Society of Mechanical Engineers is of considerable importance, as the engineer is coming more and more to be recognized as the most important factor for the organization of the home forces for war work, and his training as an organizer and executive should be brought into play at this critical time. The engineer, as such, must take his place among the forces that are active in accelerating the production of war materials.

Temporarily, the headquarters of the committee will be at the offices of G. K. Parsons, the chairman, at 29 Pine St., New York City, and all correspondence relating to the committee's work should be directed to this address. All organizations who are working along similar lines are asked to communicate with this committee of the American Society of Mechanical Engineers so that the work of all similar committees may be coordinated and the greatest effectiveness be obtained by unifying the work of all. The American Society of Mechanical Engineers is not in this work for any other purpose than to *serve* and *cooperate*, and in order to obtain the greatest efficiency all overlapping of activities by various organizations should be avoided.

Manufacturers who have equipment that is idle or that is not employed on regular war work, and who would like to have it so employed, as well as makers of munitions of war and other war material who have contracts to sublet, are also asked to communicate with the committee.

UNUSUAL OPERATIONS ON DRILLING MACHINES[1]

USE OF DRILLING MACHINES FOR MILLING, BROACHING, DRIVING STUDS, AND ASSEMBLING

BY EDWARD K. HAMMOND[2]

IMPROVEMENTS which have been made in the design of drilling machines, and a better understanding of the possibilities of these machines by shop superintendents and others who decide upon methods of performing machining operations, have led to a remarkable extension of the range of work handled on this type of machine tools. In recent articles published in MACHINERY, information has been given concerning the performance of facing, hollow-milling, and other operations which are a little in advance of what is usually regarded as drilling machine work, although such operations are handled in a great many shops that are under the management of progressive men. In the present article there will be described several unusual methods of applying drilling machines for the performance of operations that are ordinarily handled by more laborious or more costly methods.

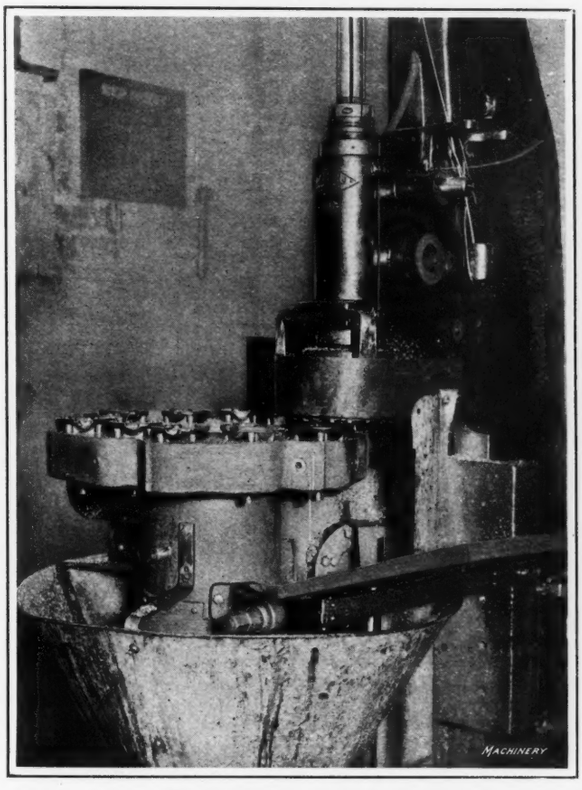


Fig. 1. Rockford Drilling Machine equipped with Continuous Milling Fixture for milling Universal Joint Rings

Drilling Machine Equipped for Milling Operation

In Fig. 1 there is shown the way in which the Rockford Drilling Machine Co., of Rockford, Ill., has equipped a high-duty drilling machine of its manufacture for use in milling universal joint rings. It will be apparent from this illustration that the work-holding fixture is so designed that the operation is conducted on what is commonly known as the "continuous" principle, that is, the fixture revolves so that forgings are constantly being fed under the milling cutter; and the operator has plenty of time to remove the milled universal joint rings from the fixture and substitute rough forgings. These forgings are made of 0.25 per cent carbon steel and are held in place on the fixture by means of T-clamps. The drilling machine used for this job is equipped with a special spindle of suitable design for driving the large inserted-tooth face milling cutter, which can just be seen projecting down below the guard that is furnished to protect the operator against injury.

Broaching Operation on Drilling Machine

Regardless of the views held by any man who plans methods of performing machining operations concerning what constitutes drilling machine work, there are few of these men who will not concede that the use of a drilling machine for simultaneously broaching eight slots is somewhat unusual. Fig. 2 shows the way in which the Willys-Overland Co., of Toledo, Ohio, has equipped a 42-inch reversing type of drilling machine, built by the Cincinnati Machine Tool Co., of Cincinnati, Ohio, for broaching eight slots in an aluminum crankcase to receive the push-rod guides, all of this work being finished by one feed movement of the drilling machine spindle. For the performance of this operation the work is located by plugs on the fixture which enter the camshaft bearing holes at each end of the crankcase. Carried by the main spindle of the drilling machine there is a pinion which drives two gears carried in cases *A*. These gears are threaded onto screws *B*, the pitch of which is such that as the gears are turned they feed down the holder carrying the eight broaches *C* at the same rate that the drilling machine spindle carries down the driving pinion. When the broaches have reached the bottom of their downward stroke, lever *D* is manipulated to reverse the direction of rotation of the drilling machine spindle, which results in backing out the broaches. The broaches are fed into the work at the rate of 12 inches per minute, with a feed of 0.006 inch per tooth, and with this equipment 120 crankcases are broached per hour.

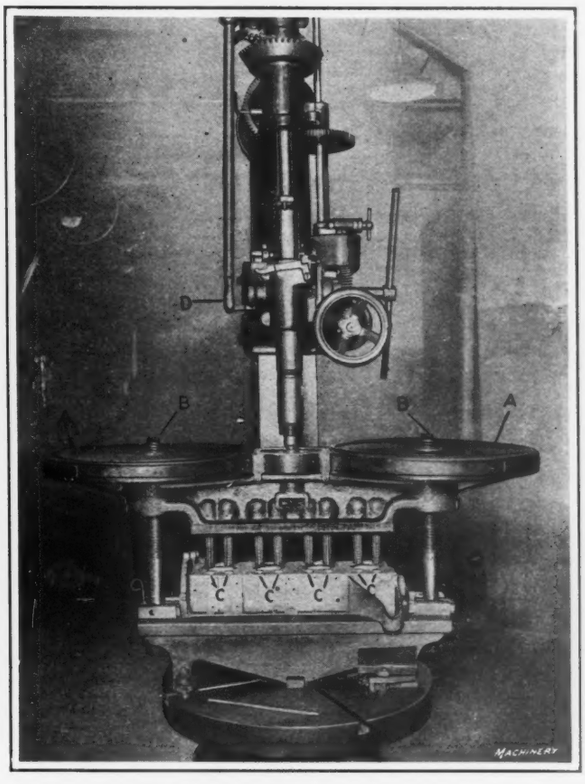


Fig. 2. Cincinnati Reversing Drilling Machine equipped by Willys-Overland Co. for broaching Push-rod Guide Slots in Crankcases

Driving Studs by Power

The Errington Mechanical Laboratory, 39 Cortlandt St., New York City, makes a stud setter of the type which opens automatically. It is equipped with two threaded jaws or

[1]For articles on drilling practice previously published in MACHINERY, see "Intensive Production on Drilling Machines," June and July, 1918, and articles there referred to.

[2]Associate Editor of MACHINERY.

half-nuts which are released and open after the stud is set, in practically the same way that an automatic die opens at the end of a cut. The opening of the stud setter is controlled by a stop-collar which is placed around the stud. When the lower end of the stud setter engages this collar, the body of the stud setter is prevented from further downward movement, but as it continues to revolve the two jaws or half-nuts screw themselves onto the stud until a collar at the lower end moves down opposite a recess or counterbored part of the stud-setter body. As this collar normally supports the half-nuts, they are released when the supporting collar enters the enlarged part of the stud-setter body. The entire tool is then raised as it continues to revolve in the same direction as for driving in the stud. The half-nuts are reset for the next stud by sliding another collar upward. This collar is recessed on the inside and engages the projecting ends of pins connected with the jaws or half-nuts, and simply serves to move them upward so that the supporting collar will be caused to enter the smaller bore of the stud-setter body and once more close the jaws ready to engage the next stud. This tool may be rotated either in a drilling machine or by means of a portable pneumatic or electric drill. Flexible shafting is also used in some cases. The general method of setting studs is to start them by hand and then drive them in by power. If a stud is too tight and requires an unusual amount of power for driving it, the stud setter can be released at any time by simply raising the machine spindle, as this moves the outer shell of the stud-setter body upward and brings the half-nuts into the releasing position. Fig. 3 shows one of these Errington stud setters being driven by a drilling machine.

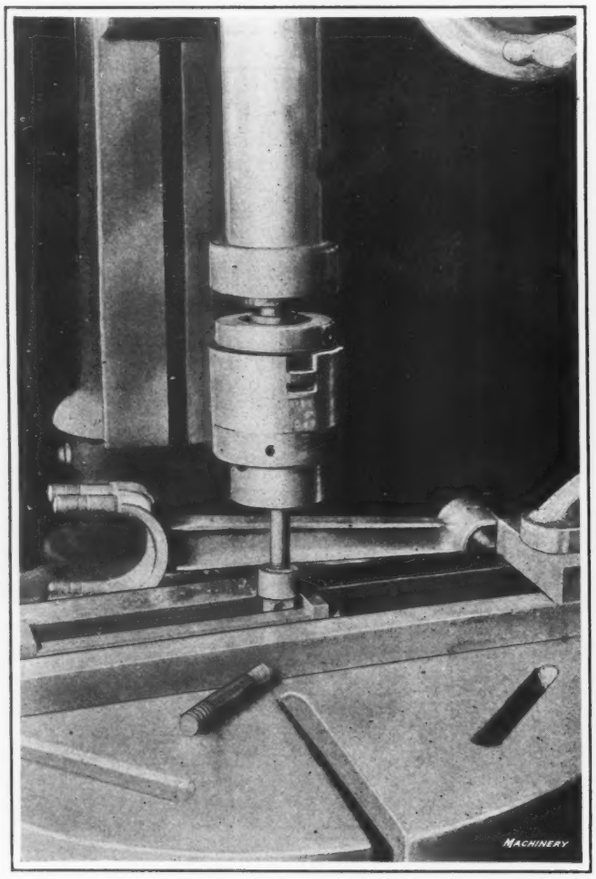


Fig. 3. Errington Stud Setter operated by Vertical Drilling Machine

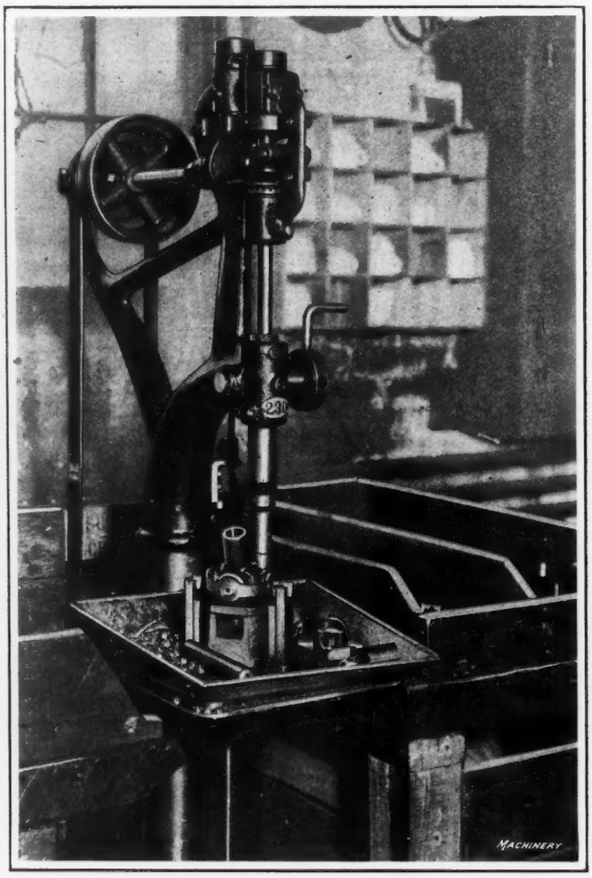


Fig. 4. Rockford Drilling Machine in Use assembling Universal Joints

Assembling under Drilling Machine

A large part of the labor of assembling machine parts that are held together by screws, bolts, and nuts is spent in the act of screwing the parts together with a wrench. When a nut is started on a screw thread, there is no reason why manual power should be employed to screw it in, provided there are a sufficient number of one size to warrant the use of power apparatus. In the manufacture of motor cars, special appliances are employed for assembling, especially for setting studs and screwing up nuts. In some cases as many as sixteen nuts are driven in simultaneously by multiple-spindle drilling machine attachments. While it is necessary for the operator to test each nut with a wrench to see that it is screwed in firmly, the power apparatus saves a great deal of time and strength. However, the use of power apparatus for setting studs and screwing up nuts is not necessarily confined to the manufacture of machinery built in large quantities. It is quite feasible to employ an ordinary single-spindle drilling machine effectively for assembling simple parts that are made in quantities, especially if they have a number of nuts of the same size that may be screwed up consecutively during one operation. The drilling machine may be used as an assembling machine in many plants where the idea has never been employed or even suggested.

Fig. 4 shows a drilling machine built by the Rockford Drilling Machine Co., of Rockford, Ill., which is used in this company's plant for tightening the four nuts on the bolts that hold together the parts of a motor car universal joint assembly. The universal joint is mounted in a fixture of the form shown in Fig. 5, which holds the ring level and thus presents the nuts to be tightened in a horizontal plane. The operator starts the nuts on the screws by hand, having all four nuts ready before placing the joint in the fixture for screwing them down. The wrench carried by the drilling machine spindle is then applied and the nut is screwed up as far as it will go or until the bolt slips. After this has been done, the fixture is indexed to the next position and the operation repeated. The fixture is essentially simple, consisting of a base that is bored and faced to receive the member on which the universal joints rest. A hardened steel ball and a coiled spring seated in a hole in the base constitute the indexing and locating plunger. It offers sufficient re-

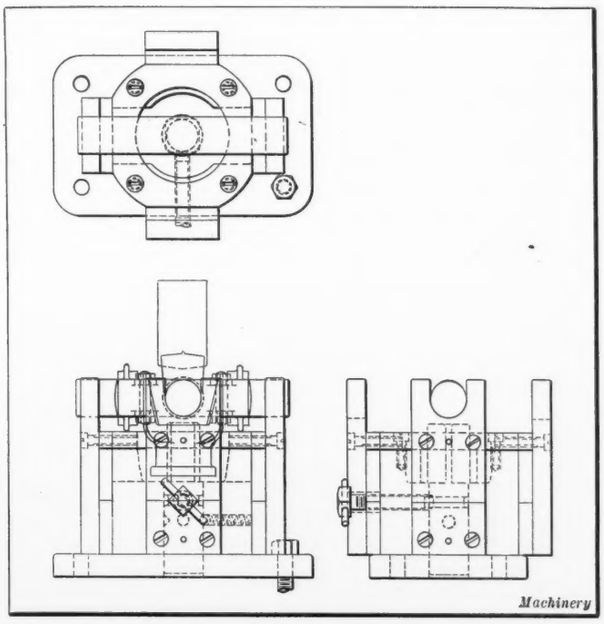


Fig. 5. Fixture for assembling Universal Joint Rings on Drilling Machine as shown in Fig. 4

sistance to hold the fixture in place, but not enough to prevent the operator from easily turning the indexing member of the fixture around to the next station.

Fig. 6 shows another method of employing a power-driven machine to assist in the rapid assembling of machine parts. Here there is shown a No. 33 "Little David" portable pneumatic drilling machine made by the Ingersoll-Rand Co., 11 Broadway, New York City, which is used in the plant of the H. H. Franklin Mfg. Co., of Syracuse, N. Y., for "running in" cap-screws. It will be seen that the pneumatic drill is suspended in such a way that the operator is relieved as far as possible from the work of lifting the tool. In this way, the fatigue factor is reduced to a minimum, enabling the operator's efficiency to remain as nearly normal as possible during the entire working day. The speed at which cap-screws may be run in by this method, as compared with the laborious method of driving them by hand, will be perfectly obvious.

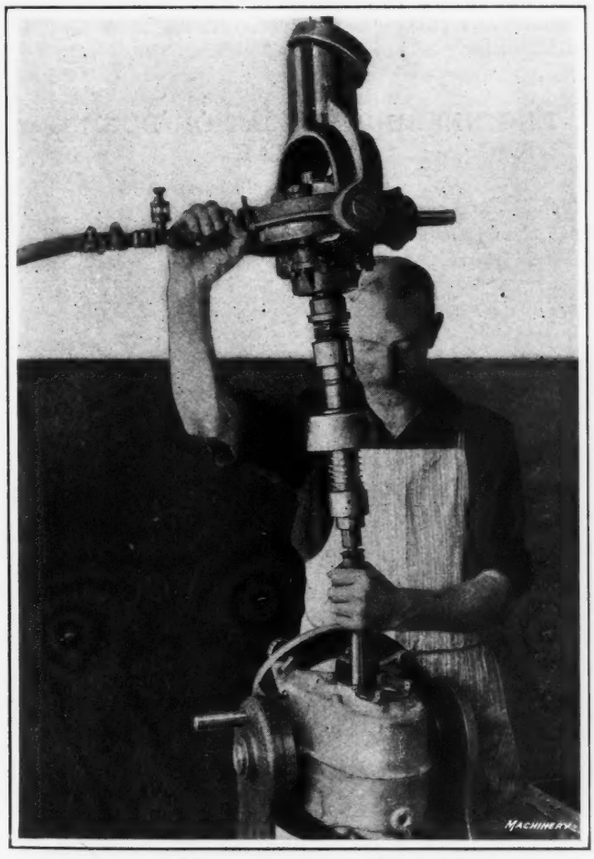


Fig. 6. No. 33 "Little David" Pneumatic Drill running in Cap-screws

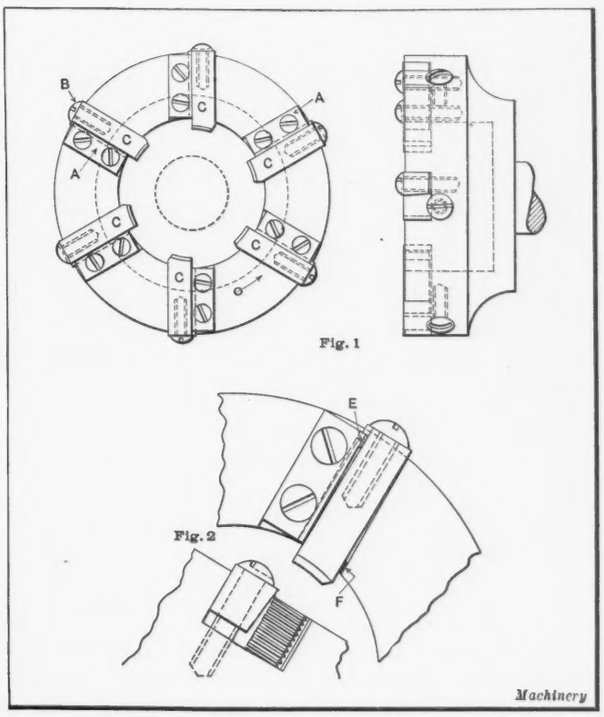
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ADJUSTABLE DIE AND METHOD OF RELIEVING CHASERS

BY HENRY DAUT[1]

In the accompanying illustration, Fig. 1 shows an adjustable threading die which was designed for cutting threads on carbureter parts. The die thread is 2¾ inches in diameter and has sixteen threads per inch. The chasers *C* are made from 1/2- by 1/2-inch high-speed steel and have a 1/16-inch taper on the front side. The clamps *A* are drawn into slots by two 1/4-inch screws having twenty-four threads per inch, which hold the cutters firmly in place. Adjustment of the chasers is accomplished by screws *B* on the outside of the die-head, which also act as safety screws to hold the chasers in place.

Fig. 2 shows the method employed in relieving the chasers. Before the thread was cut, shims 1/32 inch thick and 1/8 inch wide were placed behind the chasers on the inner end, and also between the chasers and the clamps on the outer end, as shown at *E* and *F*. After the thread was cut, the shims were taken out and the chasers hardened and ground. The chasers were then put back into place without the shims, thus obtaining the desired clearance.



Figs. 1 and 2. Adjustable Threading Die and Method of relieving Chasers

* * *

Metallography has stepped down from the halls of science to the work-shop. It is being applied today in hundreds of metal-working plants. By means of it one may obtain some of the most definite indications of the correct heat-treatment of metals and of their physical characteristics. It shows many things that cannot be determined by tests along other lines. Yet the literature of metallography has not quite descended to the level of the average practical man; the atmosphere of the laboratory still clings to it; it does not employ an everyday vocabulary. Here is a chance for practical metallurgists to provide treatises on the microscopical study of metals, in language suited to the needs of the average practical man. Heads of engineering schools should devote much more careful attention to this subject and see that all courses in practical engineering include it.

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MACHINERY

DESIGN—CONSTRUCTION—OPERATION

PUBLISHED MONTHLY

140-148 LAFAYETTE STREET, NEW YORK

England
51-52 Chancery Lane
London

Cable Addresses
Machinery, New York
Machtool, London



THE INDUSTRIAL PRESS
PUBLISHERS

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AUGUST, 1918

CIRCULATION FOR JULY, 1918, 27,000 COPIES

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GOVERNMENT CONTROL OF LABOR

The President's proclamation urging all employers engaged in war work to refrain, after August 1, from recruiting labor in any manner except through the United States Employment Service of the Department of Labor was more than an urgent request. It was an order; because, in effect, after August 1 no employer whose plant is working on war materials and who has a force of more than one hundred workers will be permitted to employ labor except through the United States Employment Service. Employers needing men will state their demands to this Labor Bureau and they will be filled according to the general needs of the country in the prosecution of the war. The authority of the Government will be exercised through the War Labor Policies Board of the Department of Labor, and the Government's request to employers will be enforced through its control over raw materials, as manufacturers who refuse to heed the President's request are likely to find themselves shut off from such supplies as coal, steel, and other essentials.

Centralized control of labor has become necessary, and employers in general will welcome the new departure. Different industries are now forced to outbid each other and under present conditions there is virtually no limit to the wages paid. It is hoped that government control will remedy this condition, and if it is exercised intelligently and not handled as a political weapon it will probably work out satisfactorily.

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ELECTRIC STEEL

One of the most remarkable of the many industrial developments during recent years is connected with the production of steel and has been made possible by the electric furnace. The demand for steel of the highest quality was never greater than at the present time, partly because of the exacting requirements for materials used in the construction of ordnance, airplane motors, and other equipment needed in connection with the war. Large quantities of steel used for purposes requiring absolute reliability and uniformity in composition and strength, are now produced by the electric process, and for this reason the article in the current number of MACHINERY, dealing with the making of electric steel and various types of furnaces used, is of unusual interest. The subject treated is not generally understood, and few men in the mechanical field not directly engaged in the making of steel realize what an important factor the electric process has become within the last decade.

The industrial importance of the electric furnace is especially marked in the production of special alloy steels, tool steel, and steel castings. With this process, it is not only possible to produce steel of exceptional purity, but it is also easy to control its constituents in the making and to reproduce accurately steel of a given composition. The phenomenal growth of this process has been greatly accelerated by the abnormal demand for steel in the last four years, but many metallurgists and steel makers believe that the present rapid expansion of the electric steel industry will continue, and that eventually this steel, which a few years ago was regarded as a kind of novelty, will comprise a large part of the entire steel output.

* * *

CONGRESS OPPOSES EFFICIENCY

The National House of Representatives went on record as being opposed to efficiency in engineering work, when it voted to over-ride the mature judgment of the Committee on Military Affairs and added an amendment to the Army Appropriation Bill prohibiting time studies and premium payments in manufacturing establishments conducted by the Government. Time studies to the House majority apparently imply that labor is driven to its task, when in fact, their general effect is quite the contrary, because only by such scientific study can useless operations and wasteful methods of doing work be eliminated. Time and motion studies make it possible to concentrate the skilled worker's efforts upon work that he can do to the best advantage, leaving other work to be performed by less skilled men, so that the skilled worker can earn a higher wage without greater exertion. Our law-makers, no doubt, thought that they were protecting labor in recording their opposition to scientific management, time studies, and premium payments; but, in fact, this vote operates as a check to the economical development of our industries, an action sufficiently bad in time of peace, but indefensible now, when the maximum production is an absolute necessity.

* * *

ENGINEERING EDUCATION DURING THE WAR

How to keep our engineering colleges working at normal pressure is one of our many war problems. Many of our young men who, under ordinary conditions, would take engineering courses, have either enlisted or been drafted; many engineering professors and instructors are also in the service of the Government. The alarming condition which confronts the country, as a consequence, is shown by M. E. Cooley, dean of the University of Michigan, writing in *The Michigan Technic*. As winning the war depends largely on our having competent engineers, it is indeed a serious matter if young men suited to the engineering profession do not complete their courses; and it is equally serious if other young men do not begin to take these courses for the purpose of fitting themselves for engineering work. Attendance has fallen off at the engineering schools and teachers are giving up their positions; but if men are to be adequately trained for engineering work both in war and peace, they must be induced to attend college, and the necessary teachers must be provided for training them.

President Wilson, in a letter to the dean of the College of Engineering of the University of Michigan, pointed out not only that technical training had become of enormous importance in military operations, but that the work of the engineer was becoming more and more important in every process of industrial life, and he expressed the hope that, so far as possible, all concerned should cooperate toward keeping young men in the engineering schools until they had finished their studies. This is a phase of the war situation that has not been given as much attention as its importance merits.

Training Men for Shop Work

WHEN the owner of a large factory was asked, "How do you fit a new man to his work?" he replied: "I say to the man, 'There is your machine; make good or quit!'" That method, with modifications, used to be the guiding principle in the employment of workers in our factories; but there has been a gradual change during recent years. It has become clear that, with the present shortage of labor, both men and women must be especially trained for the work that they are to do, if the plants where they are employed are to be run successfully.

In one factory producing time fuses for shells, which employs six thousand operators, the output has been more than doubled by the systematic training of each operator. Without this, it would have been necessary to double the plant in order to reach the present production; and, more remarkable still, the factory's labor turnover is very small, because the workers, having been carefully trained, earn high wages and, therefore, feel no desire to change their positions.

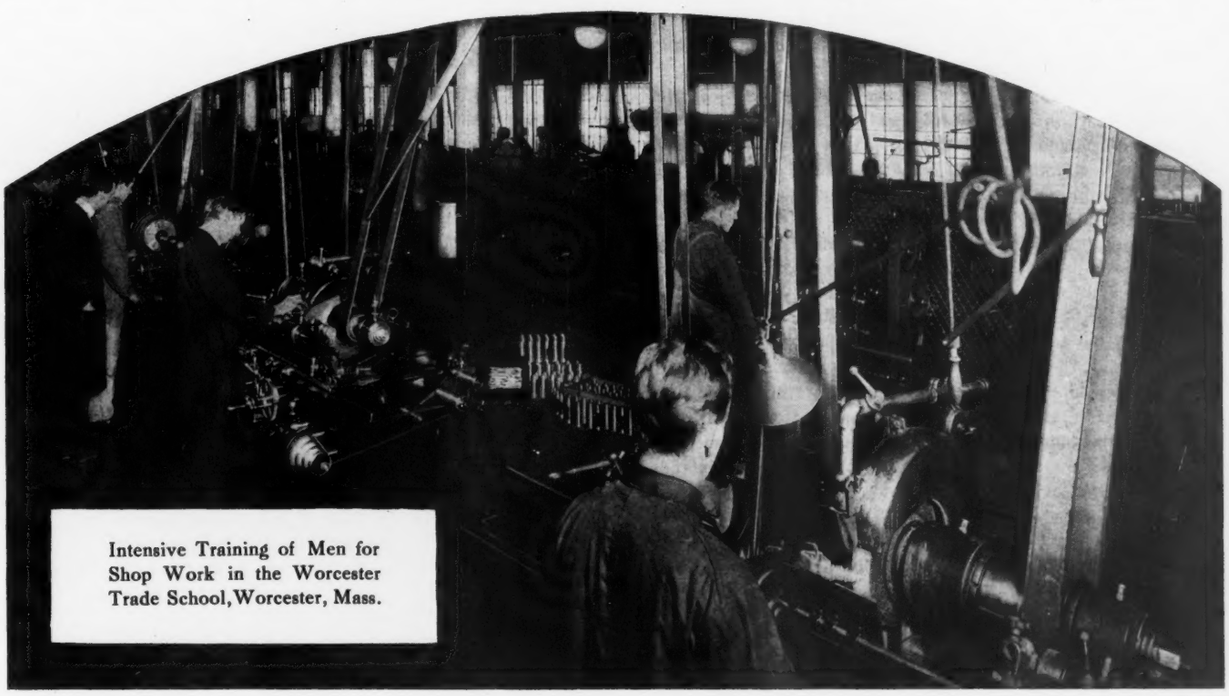
The training of operators should not be looked upon merely as a war measure, but as something permanent, something that will prove most important in solving many of the industrial and labor problems confronting employers. A properly trained worker is less likely to become dissatisfied, to dwell upon imaginary wrongs; and the wage problem as well as the question of working hours can be met satisfactorily with such workers, because their production will be increased in a ratio formerly thought well-nigh impossible.

The particular method of training that seems to have met with the most approval is this: at a factory some space is set aside in which the machines are of the same type as those on which the workers will be regularly employed later on. Able and conscientious operators from the regular staff of the factory are assigned to train new workers in the best possible methods of operation. The novices, while being trained, are, nevertheless, engaged on actual productive work; and it has been found that, owing to the instruction received, they are able to produce more, even during the training period, than ordinary operators in a factory managed in the old way. It is said that new operators, who have received from three to eight days' training, have been able, after three weeks' further experience on regular production in the factory, to produce from 20 to 50 per cent more than the old-time, self-taught operators.

The training space may be in a single room for the whole shop, or it may consist of a few machines in each of the shop's departments. In large factories, the best possible place for this training is in a department especially set aside for the purpose; in smaller factories—those that employ, say, from fifty to two hundred men, and only occasionally need a few new operators—such a training department might prove too heavy a burden. In that case, cooperative training schools for serving a number of factories in the community might be established, following the example of England, where ten thousand toolmakers, we are told, have been trained in public trade schools during the war.

A new England trade school claims that it can train screw machine operators in three days to handle their machines satisfactorily, when these are set up by experienced men, and that, on the fifth day, it can begin to teach them how to set up the machines for new jobs. The driver of a laundry wagon, for example, was taken into this training school, and, in a week, was taught to run a milling machine and to read blueprints, so that he could turn out ordinary plain milling work satisfactorily. The school is provided with material by manufacturers in the town where it is located, who want to use the men trained at the school, and, consequently, desire to have them instructed to work with material and parts identical with those with which they will work when hired. This method has reduced the labor turnover, because the men fit into their places, are successful at their work, and get good pay.

The war has taught us that, to achieve efficient production, it is just as necessary to train industrial workers even for the simplest tasks, as it is to train soldiers in order to make them efficient fighters at the front. No problem now facing our manufacturers is of greater importance than this.



Intensive Training of Men for Shop Work in the Worcester Trade School, Worcester, Mass.

THE MACHINE TOOL TRADE AFTER THE WAR

BY A. W. HENN

President, The National Acme Co., Cleveland, Ohio

THE opinions regarding the machine tool trade after the war vary considerably. There are some who claim that the machine tool business will be almost at a standstill owing to the necessity for readjustment when the war is over and to the great number of machine tools that will be released from war work. On the other hand, a great many of the leading men in the machine tool trade believe that at the end of the war there will be a continued brisk trade in machine tools for at least several years to come. The latter view seems to be the more rational. It is based not on assumption, but upon a careful study of the conditions and the factors that must be taken into account. The following paragraphs contain a review of these conditions and a brief analysis of the factors that will determine the status of the machine tool business in the United States when the world is again at peace. These conditions affect both the foreign and the domestic trade.

Demand for Machine Tools in Europe

Directly following the end of the war there will be a period of reconstruction in practically all European countries; this will be greater, of course, in those that have been devastated in the war than in others. For a period of anywhere from two to five years these countries will draw upon the United States for a great many of their necessities, including machine tools, because they will not be ready, themselves, to supply immediately more than a small part of the enormous demand for machine tools that will make itself felt at once. They must have their factories running at full blast, in order to be able to rehabilitate themselves economically; and to do this it will be necessary for them to obtain just as rapidly as possible the full quota of machine tools that will be required for fully employing their peoples.

Belgium offers, of course, the most striking example of what will be necessary for the rehabilitation period. We understand that practically all the machine tools have been removed from Belgium and those that have not been removed have probably been run day and night for years, until they are practically valueless. Hence, it is reasonable to assume that the complete machine tool equipment of the whole of Belgium will have to be immediately replaced. While Belgium is a comparatively small country, it was and will be, in proportion to its size and population, one of the most highly industrial of the countries in Europe, and the number of its factories is relatively great. The machine industry of Belgium was especially highly developed, and it is probable that the number of machine tools in proportion to the population was greater in Belgium than in any other country in the world. To supply that nation with the necessary tools, therefore, will in itself be no small task.

Belgian manufacturers who escaped from Belgium at the time of the occupation by Germany are now looking forward to this period of reconstruction, and some of them have already placed orders in the United States for machine tool equipment to be delivered immediately upon the signing of the peace declarations. The National Acme Co. has one such order on its books at this time. Conditions similar to those in Belgium exist in northern France, part of which is also highly industrial; but those countries which have not actually been devastated by the war will also place heavy demands upon the machine tool industry. The machine tools in France, England, and Italy at the present time are being run at their maximum capacity, and at the end of the war they will be found to be practically worn out. The high efficiency that will be required during the reconstruction period, in order that the nations as soon as possible may again be able to return to normal industrial conditions, necessitates the best machine tools and equipment of all kinds. Hence, there will be a demand for new and efficient machine tools that cannot be immediately filled by these nations themselves, but which must be met by the United States, where, because of our natural resources and the size of our population, we will be able to retain reasonably normal industrial conditions throughout the war, and we should, therefore, be able to supply other nations with their machine tool requirements almost immediately upon the termination of hostilities.

Second-hand Tools are Not a Big Factor

It has been believed by some men in the industries that after the war a great many machine tools will be thrown upon the second-hand tool market, and that this will materially affect the market for new machine tools. This, however, is not likely to be the case. The machine tools today in our munitions factories, as well as in our other machine building plants, do not receive the usual care and attention. They are in many cases run by untrained and careless operators and will be, generally speaking, in a bad condition when the war is over. They will have little or no value for first-class work, and while they may be used to supply some smaller and less important factories, the second-hand machine tools will probably not be a big factor in the machine tool trade. Hence, it is reasonable to assume that the domestic market for new tools will also be quite brisk, and it will be several years after the end of the war before there will be any material depression in the machine tool market.

Normal Demand Compared with War Demand

The normal demand for machine tools at the end of the war will not, of course, compare with the high-pressure demand during the war, and the curve indicating the amount of business done will, no doubt, drop slightly. It may now have reached its maximum, and we know that it always has its hills and valleys. It will not go below normal, however, for several years to come, on account of the conditions outlined above. Its return to normal is perhaps rather to be desired in many instances, because it has many advantages for the manufacturer which are absent when the demand is at its present height. A return to normal demands will stabilize the labor supply and wages. It will make it possible to conduct business in a more efficient and economical manner. It will stabilize prices and, in general, put the business on a firm foundation.

Conclusion

Summing up, therefore, what has been said, I believe that the machine tool trade will be fully, or above, normal, for several years after the war, because Europe will have to place itself on an efficient and highly productive industrial basis, and it will be necessary to replace the machine tools that have been either removed, as in Belgium and northern France, or that have been worn out like those used in the munitions factories all over Europe. The second-hand market will not materially affect the market for new machine tools, because most of the tools that will be available in the second-hand market will be practically worn out, out of alignment, and, generally speaking, unfit for use in the best classes of machine shops.

* * *

Large additions to the country's steel-making capacity were made in 1917. Ninety-seven new open-hearth furnaces, capable of an output of 4,326,500 tons of ingots per year, were completed. Of this total, 1,220,000 tons is furnished by the United States Steel Corporation. In 1916, previously the record year, the new capacity added was 4,205,000 tons. Fourteen new blast furnaces were blown in during 1917, with an annual capacity of 2,520,000 tons, against only five furnaces in 1916, with a capacity of 800,000 tons. Yet the pig iron production in 1917, estimating that of December at 3,000,000 tons, was 735,000 tons less than in 1916.



Ball Bearings for Machine Shop Equipment—1

By Edward K. Hammond[1]

MACHINE designers who have not given a great deal of consideration to the advantages secured through the use of ball bearings in mechanical equipment for the machine shop, are inclined to think that power saved through the elimination of friction is the chief advantage secured through the use of this type of bearings. As a matter of fact, they have many other equally important advantages among which are the reduction of wear, which overcomes the necessity of "taking up" bearings at specified intervals; the possibility of packing these bearings in a supply of lubricant which is sufficient to last for a considerable period of time, thus reducing the amount of attention required; and the fact that ball bearings operate with practically no wear, so that shafts or spindles supported by them are held in accurate alignment.

Some of the more conservative machine tool builders concede the possibility of saving power, but it is the opinion of these men that the ball bearings are relatively short-lived and so the saving of power is secured at the expense of having to make frequent machine repairs and replacements of ball bearings. The idea that ball bearings are incapable of giving prolonged service has doubtless been carried over from the days when bicycle riding was at its height. Ball bearings used in bicycles were the means of enabling these machines to run much more easily, but the bearings were often made of unsuitable grades of steel which had been poorly heat-treated; and to add to these undesirable conditions, the bearings themselves were improperly designed. It followed as a natural result, that they were unable to give satisfactory service. Everyone who has had experience with bicycle riding concedes that even these crude ball bearings were certainly the means of saving power.

Just criticism of ball bearings on the ground that they are short-lived has now been completely overcome. Bearings of this type were required for use in automobile construction, and here the incentive to develop efficient bearings was sufficiently great so that the requisite amount of money was forthcoming to have the problem studied by thoroughly capable engineers and designers. As a result, various types of ball bearings have been developed which are well suited for those classes of service in which they are used. Much thought has been given to the selection of suitable grades of steel for making parts of the bearings; and methods of machining and heat-treating these parts to give them the required accuracy and physical properties have been developed to such a degree of perfection that today the ball bearing represents one of the most perfect forms of mechanism which is manufactured on a commercial basis. Last, but far from least, as regards the successful application of ball bearings in machine shop equipment, a great deal of study has been given by competent engineers and machine designers to the requirements that must be fulfilled in mounting ball bearings and providing for their efficient lubrication. It is our purpose to present, as far as possible, information concerning the latest developments in the application of ball bearings in machine shop equipment.

[1]Associate Editor of MACHINERY.

Requirements of Efficient Ball Bearings

In the preceding paragraph a brief idea has been given of the degree of perfection which has been attained in ball bearing manufacture, but the reader will doubtless be interested in a specific, though brief, statement of the actual facts. First of all, it is of absolute importance to make the bearing parts of a suitable grade of steel of the required chemical analysis, and this steel must be heat-treated in such a way that the balls and races are hardened right to the center. If there is any lack of uniformity in the hardness of different parts of the bearing, this will manifest itself by a variation in the amount of compression of these parts under load, and such a condition would seriously impair the efficiency of operation of the bearing. The process of machining the balls and races must be carried on with the greatest care, because it is required to have the surface of the balls and the races in which they run ground to a remarkable degree of precision, and the dimensions must be held within exceptionally close limits.

It is an accepted fact among experienced ball bearing engineers that any roughness on the surface of the balls or races will result in the rapid destruction of the bearing; it is only where bearings with perfectly finished and properly heat-treated parts are used in shops where the necessary care is given to lubrication, etc., that the statement can be made that this type of bearing is practically free from wear. Last, but not least, it is necessary to have the races ground so that they do not depart from the true circular form, and to have a variation of not over 0.0001 inch in the diameter of balls used in any one bearing. The reason for this is that lack of uniformity in the size of the balls, or deviation from a true circular form in the races, would result in an uneven distribution of the load so that certain sections of the bearing would be subjected to excessive stresses which might be sufficient to start wear. Properly made balls and races will last for a long time before they start to show signs of wear, but experience has shown that when a ball bearing once begins to wear its complete destruction is rapidly accomplished. The

finish secured in polishing the balls and race grooves should be so perfect that it is impossible to detect the slightest scratch when the surfaces are viewed through an ordinary pocket magnifying glass.

Effect of Ball Diameter and Race Contour on Load-carrying Capacity

Assuming the steel used in making ball bearings to be the same in all cases, the load-carrying capacity of a ball bearing is determined by the size of the balls and the dimensions and form of the raceways. Other things being equal, the larger the ball, the greater will be its capacity to support a load. Similarly, the ability of a ball bearing raceway to carry the load imposed upon it by the balls will increase steadily as the curvature of the groove is made to conform more closely with the curvature of the balls running in that raceway. These statements of facts that are well known to men of experience in the design and use of ball bearings will naturally cause the machine tool designer who has not had a great deal of experience with bearings of this type to ask the reason for these variations in the load-carrying capacities of different bearings. Briefly stated, these reasons are as follows: In order for a steel ball to fail under a load imposed upon it, the ball must be broken by crushing. All materials are elastic to a certain extent, and in the case of a ball under load, this elasticity results in the points of contact between the ball and the surfaces pressing on it being flattened out somewhat, so that instead of the theoretical point contact there is actually a surface contact. When the load is great enough to distort the ball beyond the elastic limit of the steel, the ball is crushed. The area of the surface of contact between a ball and a flat surface, owing to the application of a specified pressure upon the ball, will increase steadily as the size of the ball increases. It will be apparent that this naturally gives the larger ball capacity for supporting a greater load because the load per unit area of contact will be less for a large ball than for one of smaller size. Now let us consider the case of variation in the curvature of the ball raceway. For races of the same size and subjected to the same load, the area of contact due to distortion of the ball and raceway by the load will increase steadily as the radius of curvature of the raceway becomes more nearly equal to the radius of the ball. For this reason, the pressure per unit area will decrease steadily as the curvature of the raceway approaches that of the ball, and so the load-carrying capacity will increase.

Relation of Race Contour to Frictional Resistance

Where other conditions are kept uniform, it is found that frictional resistance in a ball bearing—although very small under any conditions—increases from a minimum amount which is present when a ball is rolling in contact with a flat surface, up to a maximum amount that exists in the case of a ball running in raceways of the same curvature as the ball. Although a uniform increase in load-carrying capacity is accomplished by making the radius of curvature of grooves in the raceways approach that of the balls, it is considered good practice to design ball bearings in such a way that a mean curvature is provided, which represents a balance between the minimum amount of friction in the case of balls running on a flat surface and the maximum load-carrying capacity secured through having the balls run in contact with raceways of the same curvature as the balls. For instance, the Gurney Ball Bearing Co., of Jamestown, N. Y., has adopted the following standard curvatures for the raceways of bearings carrying different sizes of balls: For bearings provided with balls up to 15/16 inch in diameter, the curvature of the inner raceway is 4 per cent and the curvature of the outer raceway is 6 per cent greater than that of the balls. For bearings provided with balls ranging from 1 to 1 15/16 inch in diameter, the curvature of the inner raceway is 3 per cent and the curvature of the outer raceway 4 per cent greater than that of the balls. For bearings provided with balls 2 inches in diameter and larger, the curvature of the inner raceway is 2 per cent and the curvature of the outer raceway 3 per cent greater than that of the balls.

Load-carrying Capacity of Radial Ball Bearings

The load-carrying capacity of a ball bearing and its length of life is also dependent upon the number of balls in the bearing, the perfection of finish of the balls and the raceways in which they run, and the speed of rotation of the shaft carried by the bearing. These and other conditions affecting the load-carrying capacity to which reference has been made in preceding paragraphs are connected in the following formula for the load which may safely be put upon a radial ball bearing:

$$P = \frac{KZD^2}{5} \qquad (1)$$

where

P = safe working load in pounds;
K = constant depending upon shape of raceways and their condition;
Z = number of balls in bearing; and
D = ball diameter expressed in eighths of an inch.

Formula (1) applies to ball bearings operating under conditions of uniform load and speed, and in the accompanying table there are given values of constant K corresponding to different speeds of rotation. It will be apparent from this table that the speed of rotation is a highly important factor in determining the load-carrying capacity of a ball bearing. This is due to the fact that the steel must have an appreciable

VALUES OF CONSTANT K FOR VARIOUS SPEEDS OF ROTATION

R.P.M.	10	150	300	500	1000	1200
Constant	48.4	36.3	29.14	24.2	20.9	15.62	14.96
R.P.M.	1500	2000	2500	3000	4000	5000	10,000
Constant	13.6	12.1	10.56	9.68	8.58	7.70	5.06

Machinery

time to recover from a condition of distortion before it is once more subjected to a heavy load. In most cases, ball bearings are so mounted that the outer race remains practically stationary, this race being supported in such a way that it creeps slowly around in the housing in which the bearing is held. As a result, the load is concentrated on about one-fifth of the circumference of the outer raceway. Another feature of having the outer race free to move slightly in its housing is that this race can adjust itself longitudinally so that the ball tracks in the inner and outer races are in accurate alignment with each other. Movement of the inner race brings its entire circumference into contact with the balls at each revolution of the shaft. In selecting a suitable size of bearing to meet the requirements of given conditions of service, the load P is known and the constant K may be taken from the table, if the speed of rotation of the shaft is known. This leaves the number of balls Z in the bearing and their diameter D as the two factors to be determined, and these are selected in such a way that they satisfy the conditions of the equation.

Load-carrying Capacity of Ball Thrust Bearings

As in the case of radial bearings, the selection of thrust bearings to meet the requirements of any known conditions depends upon the nature of the service required of them. Where there are only light loads of uniform intensity to be carried at low speed and at infrequent intervals, a bearing of small capacity will give the required service. Conversely, if heavy loads and severe shocks have to be carried by a ball thrust bearing, and if the shaft runs at high speed and for many hours each day, we have the most severe class of service. Of course, there are a great many cases where the service required of a bearing comes midway between these extreme conditions. The load-carrying capacity of a ball thrust bearing depends upon the shaft speed and the size and number of balls. The lower the shaft speed, the higher will be the load-carrying capacity, although this is not an exact inverse proportion. Conversely, the larger the size and the greater the number of balls in a bearing, the higher will be its load-carrying capacity. Formula (2) expresses the con-

ditions governing the load-carrying capacity of a ball thrust bearing.

$$P = \frac{K_1 N D^2}{\sqrt[3]{S}} \qquad (2)$$

where

P = safe working load in pounds;
K_1 = constant ranging from 25 to 40 according to quality of steel;
N = number of balls in bearing;
D = ball diameter expressed in eighths of an inch; and
S = R.P.M. of shaft.

What has been said about the use of Formula (1) for determining the load-carrying capacity of radial ball bearings, applies equally to the use of Formula (2) for determining the load which may be safely carried by a ball thrust bearing.

Economy of Space through Use of Ball Bearings

Where ball bearings are substituted in place of plain bearings a considerable amount of space is often saved because of their more compact design. Rubbing friction in plain bearings must be kept down within reasonable limits by making the bearings of sufficient diameter and length so that the pressure per unit of projected bearing surface is not too high. With the ball bearing there is a true rolling action between the balls and races, so that the load can be carried by bearings of much more compact form. This saving in space is often a great advantage in cases where a compact design is a matter of importance. For instance, this is particularly true in the case of equipment built for use in exceptionally congested plants. In order to give a more concrete idea of the amount of space which may sometimes be saved through the substitution of ball bearings for plain bearings, attention is called to Fig. 1, which shows the mounting of SKF ball bearings in an electric motor. This mounting is shown above the center line of the shaft, while below the center line are shown the old plain bearings which were formerly used. In this case, it will be apparent that the saving in space amounts to approximately 50 per cent of that formerly occupied by the plain bearings.

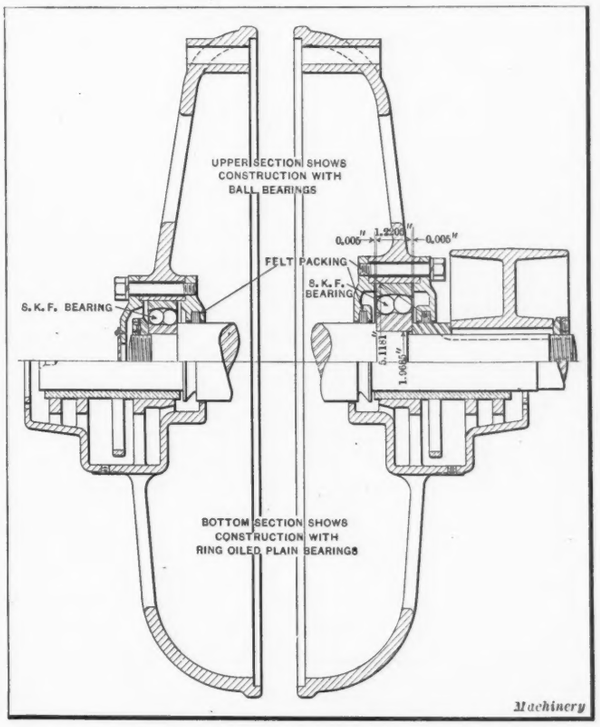


Fig. 1. Example of Space saved through Substitution of Ball Bearings for Plain Bearings

Precautions to Observe in Substituting Ball Bearings for Plain Bearings

It often happens that a builder of drilling machines or some other form of mechanical equipment may decide to substitute ball bearings for plain bearings at certain points on the machines. This action is often prompted by the fact that a competitor is selling a ball bearing equipment of somewhat similar design. In small shops which have inadequate engineering facilities—and sometimes in establishments which are better equipped—it happens that the substitution of a ball bearing for a plain bearing is carried out somewhat in this fashion. For the sake of discussion, we will consider that a decision has been reached to substitute a ball thrust bearing for a plain set of thrust collars. The drawings are scaled up and it is found that a certain amount of space is available for the ball bearing; then, after this amount of space has been ascertained, reference is made to the catalogues of ball bearing manufacturers to find out where a bearing can be obtained that will fit into this space. Satisfactory results cannot be expected from such haphazard methods of procedure, because it is a matter of absolute importance that a ball bearing be of the proper size to sustain the load that it is required to carry. If the effort is made simply to find a ball bearing that will fit into the available space on a machine which was formerly occupied by a plain bearing, the chances are that the bearing will not be the one best adapted for the peculiar conditions of service under which it is to be used. Probably the failure of ball bearings to give satisfactory results when selected by these slipshod unscientific methods has been one of the most fertile fields for failure, and has been one of the important reasons why some builders of machine shop equipment have reached the conclusion that it is difficult to obtain satisfactory results through the application of ball bearings in their products. It is therefore important that the prospective user submit his selection for approval to the ball bearing manufacturer.

Power Saved by Ball Bearings

Engineers and machine designers who have not had a wide experience with the use of ball bearings are inclined to think that saving of friction and consequent improvement of transmission efficiency are the main advantages secured through the use of bearings of this type. As a matter of fact, other equally important advantages are secured. Important among these are practical freedom of ball bearings from wear so that they require no adjustment, the possibility of mounting the bearings in such a way that they may be provided with a supply of lubricant sufficient to last for several months, and other allied advantages. The saving of friction is, however, a very important feature of ball bearings as compared with plain bearings, and the following examples are cited in order to show about what savings may be expected. In this connection it is very important to note that the reduction of friction and improvement of transmission efficiency, where ball bearings are substituted for plain bearings, may run anywhere from nothing up to nearly 100 per cent. The amount of saving will depend entirely upon the conditions of service.

Engineers of the SKF Ball Bearing Co., who have made a careful study of power losses resulting from frictional resistance in the bearings of transmission equipment and machinery used in industrial plants have estimated that 40 per cent of the total amount of power developed by the prime movers is wasted in overcoming friction. Regardless of whether power is generated in a plant maintained by a large industrial corporation or whether it is bought from an electrical generating station, it is obviously important to devise methods of reducing friction losses as far as possible, and the manufacturer cannot feel that he is running his plant under maximum conditions of economy until every precaution has been taken to reduce friction losses to an absolute minimum. One well-known expedient which has been adopted in order to overcome losses of power due to friction consists of the substitution of anti-friction bearings—either ball bearings or roller bearings are commonly employed—in order to substitute the practically frictionless rolling action of bearings of this type for the rubbing action of plain bearings, where there is sure to be a considerable amount of frictional resistance

between the surfaces which are in contact with each other. Investigations conducted to ascertain the amount of power wasted in overcoming the frictional resistance of plain bearings, that could be saved through the substitution of ball bearings, have shown that under favorable circumstances 60 per cent of the lost power could be saved; that is to say, 24 per cent of the total energy developed by the prime mover or drawn from electric power circuits. Certainly this saving is great enough to warrant giving the matter careful consideration.

In order to show how important the saving of power effected through the use of anti-friction bearings may become under certain conditions, attention is called to the experience of a manufacturing plant which was so situated that space was

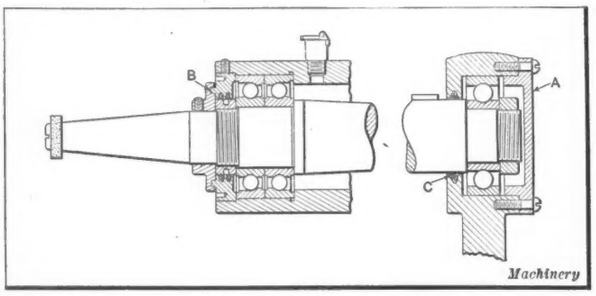


Fig. 2. Different Types of Sealing Devices for Ball Bearing Mountings, to provide for holding in Oil and excluding Dirt

at a great premium. This firm decided to add certain departments, which made it necessary to provide additional power capacity for driving the new equipment which was to be installed in the factory. After a great deal of planning, space was found for the new manufacturing departments, but the management spent a lot of time trying to figure out where the new power plant could be put without reaching a satisfactory conclusion in regard to the matter. Finally, the superintendent of this plant suggested that by substituting ball bearing shaft hangers in place of the plain bearing hangers which were then in use, a sufficient amount of power would be saved to enable the existing power plant to drive all of the equipment. The power load of the plant was 1200 amperes and under existing conditions of the transmission equipment in the factory, all of this power was required to drive the machines already in use. When the lineshaft hangers were equipped with ball bearings made by the Gurney Ball Bearing Co., of Jamestown, N. Y., it was found that 800 amperes was plenty to drive all of the equipment in the original plant, thus leaving 400 amperes to meet the power requirements made necessary by the extension of manufacturing facilities. This was more than ample to provide for driving all of the new machines that had to be installed and relieved the management of the embarrassing problem of furnishing space to install additional power plant equipment. These ball bearings were thus the means of saving the investment in a new power plant, and they are earning an income represented by the total of the interest on money which it would have been necessary to invest in the power plant, the cost of operating this plant, and the annual rental value of the space which the new power plant would have occupied.

The Transmission Ball Bearing Co., 1050 Military Road, Buffalo, N. Y., retained Roderick J. Parke, electrical engineer of Toronto, Canada, to conduct an exhaustive series of tests to determine the relative efficiency of shaft hangers equipped with "Chapman" type ball bearings of this firm's manufacture and with plain bearings, respectively. The results of this investigation led to the conclusion that when a shaft 2 15/16 inches in diameter is running under its maximum normal load, substitution of ball bearings for plain bearings is responsible for an annual saving of $19 per bearing, this estimate being based upon power at $30 per horsepower per year, which is a conservative estimate. The tests upon which this figure is based were conducted by Mr. Parke under laboratory conditions which gave him the opportunity of obtaining conditions of loading on the bearings that duplicated, as nearly as possible, the conditions imposed by belt pull, etc., when the bearings are actually at work in a factory.

Lubrication of Ball Bearings

Successful operation of ball bearings, and consequently of the machines in which they are used, depends to a considerable extent upon the observance of certain precautions in their lubrication, maintenance, and inspection. The fact that ball bearings need little attention often leads users to think that no attention whatever is required after the ball bearings are once installed. It is of paramount importance for the bearings to be properly lubricated for the following reasons: (1) To protect the polished steel surfaces against rust. (2) To facilitate the axial movement of the outer race and also to assist in the slow rotating movement of the outer race. Inasmuch as the friction in ball bearings is slight, the consumption of lubricant is very small; therefore, only lubricant of the best quality should be used.

It is often rather difficult to reach a decision in the selection of the correct type of lubricant for ball bearing installations, chiefly on account of local conditions. Experience has shown that a suitable lubricant can only be found by experiment. In most cases it is possible for ball bearing manufacturers to make tentative recommendations of lubricants that have proved satisfactory in similar installations. In addition to this, it is possible for the user of ball bearings to secure the cooperation of a number of prominent manufacturers of lubricants, who will be in a position to make definite recommendations for a suitable grade of lubricant, covering the various individual installations. Generally speaking, a heavy grade of mineral oil will be satisfactory in the majority of cases. In many cases, however, such operating conditions as inaccessibility of the bearings, the slow speed at which they run, etc., make it necessary to use grease, and experience in this connection has made it possible for engineers experienced in the design and operation of ball bearings, to recommend a suitable grade of grease for such conditions.

At high temperatures, the viscosity of the lubricant should be such that its retention in the bearing housing will not be a matter of difficulty. When at very low temperatures, the lubricant used should not congeal at the lowest temperature at which the machine is called upon to operate.

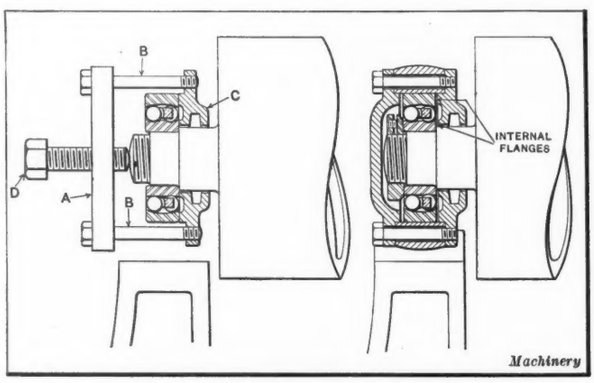


Fig. 3. Provision made in Ball Bearing Mounting for disassembling without Damage to Balls and Races

For high-speed applications, a light spindle oil will usually give the best results, although there have been cases in high-speed installations where the substitution of a heavy oil for a light oil has resulted in a much cooler running bearing. This may be explained by the fact that the inertia of a heavy oil is such that when the bearing is once up to speed, less resistance is offered to the rotation of the balls. In addition to this, there is an absence of frothing. Freedom from air pockets in the oil allows the heat to be transmitted to the outer casing more readily than if air pockets were present. In all high-speed installations, it is necessary to see that there is very little oil in the bearing housings. A large quantity of oil will cause churning and heating.

Chemical neutrality is the principal requisite of a ball bearing lubricant, that is, freedom from acid or alkali.

Most lubricants contain a small amount of acid due to the methods of refining, and to neutralize this acid, alkali is introduced into the lubricant. As the presence of either acid or alkali in a lubricant is highly injurious to the finely polished steel surfaces, it is necessary to use only those lubricants where the acid content is not greater than one-tenth of one per cent. As practically all lubricants will develop free acid with age, it is desirable to have the alkali content slightly greater than the acid content, but in no case should it be greater than one-tenth of one per cent. The excess of alkali over the acid will tend to neutralize any free acid which may later develop in the lubricant. There is a tendency for the acid content of a lubricant to increase when subjected to high temperatures. This is particularly true in the case of grease, and where ball bearings are operating under such conditions, it is advisable to test the lubricant after subjecting it to the actual operating temperatures under which it will be used, in order to ascertain whether there has been an abnormal increase in acidity.

Should it be impossible to obtain laboratory tests to determine the acid or alkali content, the following tests will determine whether or not the lubricant is suitable for use with ball bearings:

Litmus Test—Take a sample of the lubricant and wash it thoroughly with warm water. The water should then be tested with neutral litmus paper and should a faint reddish tinge show on the paper, the lubricant should be rejected as unsuitable.

Exposure to Atmosphere—Take a piece of highly polished steel and wrap it in cotton waste, which has been dipped in the lubricant to be tested. Place the steel wrapped in oil-soaked waste on a hot stove for a period of from eight to twelve hours or expose it to the sunlight for a few days. If, at the end of this time, the polished surfaces of the steel appear dull, the lubricant should be rejected as unsuitable.

Barium Chloride Test—Prepare a saturated solution of barium chloride in distilled water; dilute an ounce of the oil with one ounce of high gravity gasoline to thin it, then add six or seven drops of the barium chloride solution. If sulphuric acid is present, a white deposit or precipitate will be formed.

Copper Test—A simple test for acidity may be made by immersing a piece of highly polished copper in the lubricant

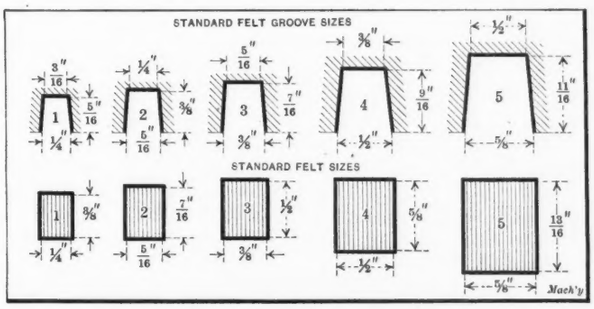


Fig. 4. Diagram showing Standard Sizes of Felt Packings and Grooves adopted by S K F Ball Bearing Co.

for twenty-four hours. Should the surface of the copper appear dull at the end of this time, the lubricant contains acid and should be rejected as unsuitable for use with ball bearings.

The renewal of lubricant in ball bearing mountings depends to a great extent upon the operating conditions of the machinery. In the ordinary type of installations, operating under normal conditions, renewal should be made about once every two months, although close observation for a short time after installation will enable a closer estimate of this period to be made. When renewing lubricant, the housing should be thoroughly washed out with gasoline. After the old lubricant has been removed, drain plugs should be again inserted and the housing filled with gasoline. If it is possible, the bearings should be rotated a few times so that each part of the bearing is brought under the cleansing influence of the gasoline. The drain plugs should then be removed and the housing carefully drained. The bearings should not be allowed to stand in gasoline because of their liability to rust and tarnish. If the machinery, after being lubricated again, should not be started immediately, it will be advisable to turn over the rotating parts at least once so that all parts of the bearings may become coated with the lubricant, thereby insuring protection against corrosion. The quantity of lubricant to be inserted depends on the size of the housing, the service conditions, and the speed.

When using grease as a lubricant for ball bearings, it is recommended that the first lubricant be applied by means of a grease gun through the lubricating openings and not by removing the end caps. This will reduce the chance of foreign matter entering the bearings and will also eliminate much of the possibility of injury to parts of the bearing. Care should be exercised to avoid putting too much grease into

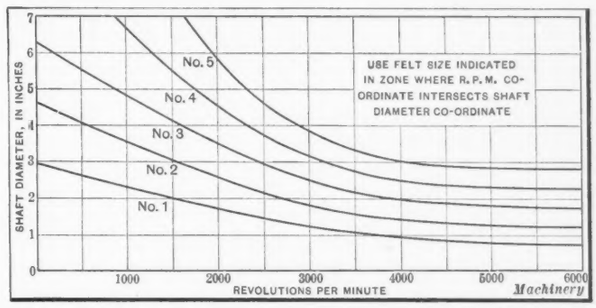


Fig. 5. Chart used for selecting Proper Size of Packing for a Given Ball Bearing Mounting

the housing, as this will result in its being forced out through the packings. An inspection of the machines during the early period of installation will enable the user to determine the proper amount of grease to be added. Lubricating plugs or caps of supply pipes must always be screwed up tight after the lubricant is inserted to avoid the entrance of dirt during the operation of the ball bearings; and the greatest care must be exerted to avoid dust, filings, and metal chips from getting into the bearings.

Designing Mountings for Ball Bearings

In designing mountings for radial ball bearings, it is the usual practice to provide for securing the inner race to the shaft or other rotating member, while the outer race is left free to rotate slowly inside the mounting. Two reasons for this procedure are that the outer race is allowed to revolve so that wear is uniformly distributed, and to enable this race to move very slightly in a longitudinal direction in order to align the inner and outer races accurately with each other. Mountings for ball bearings should be made in such a way that they will retain oil or grease in the bearing and exclude dirt and other foreign matter which would tend to accelerate the rate at which wear takes place. In Fig. 2 there are shown three methods commonly used for sealing ball bearing mountings. At *A* it will be seen that a cap is designed to be a tight fit over the end of the mounting, so that the joint produced is both oil-tight and dustproof. This is easily accomplished, because the cap is secured to a stationary machine member. At *B* is shown what is known as a "labyrinth" seal, consisting of a circular tongue on a stationary mem ber which enters a corresponding groove cut in a rotating member. A clearance of from 0.001 to 0.003 inch is provided between the tongue and groove, and this space becomes filled with grease which constitutes an efficient seal. At *C* is shown a third method of sealing the joint between the mounting and the rotating shaft. This consists of machining a groove in the housing which may be filled with either grease or a felt packing to provide for the exclusion of dust.

Designing Mountings for Ball Bearings with Provision for Disassembling

In designing mountings for ball bearings, it is important to provide for having one raceway fixed and the other arranged so that it is free to creep around very slowly in its housing. When a shaft is the rotating member, the correct practice is to have the inner race secured to the shaft and the outer race free to move slowly around in its mounting.

Conversely, when a loose pulley rotates on a shaft, the outer race should be secured in the pulley and the inner race arranged so that it can creep around on the shaft.

In developing the mountings for ball bearings, it is common for the designer to produce a form that is satisfactory in other respects, but that is likely to give trouble due to failure to provide a means of disassembling the balls or races. In almost all cases the inner race of the bearing is made a light press fit on the shaft which is to be carried by the bearing. It will be apparent that if an attempt is made to pull the bearing off the shaft by applying pressure to the outer race, this will result in pulling the inner race off its press fit on the shaft through force applied on the inner and outer races by the balls, as a result of lateral movement of the outer race relative to the inner race. This pressure applied by the balls may become so great that slight checks or indentations will be produced in the races, and when such damage is done, a hammering action will be set up in the bearing when it is put back into service that will cause it to be rapidly destroyed. In Fig. 3 there is shown the design for a ball bearing mounting developed by the S K F Ball Bearing Co., which effectually overcomes damage to bearings through lack of suitable provision for disassembling. It will be seen that a cross-bar *A* and screws *B* are provided to fit into threaded holes in the cap *C* which seals the bearing mounting at one end. This cap *C* is so designed that when pulled against the bearing by tightening screw *D*, the inside of the cap engages both the inner and outer races of the bearing, and when the screw is tightened up still further, cap *C* applies a uniform pressure to the inner and outer races with the result that the inner race is pulled off its pressed fit on the shaft without any tendency for the outer race to move laterally in relation to the inner race. In this way, the bearing can be d i s a s s e m b l e d without any damage being done to the balls or races of the bearing.

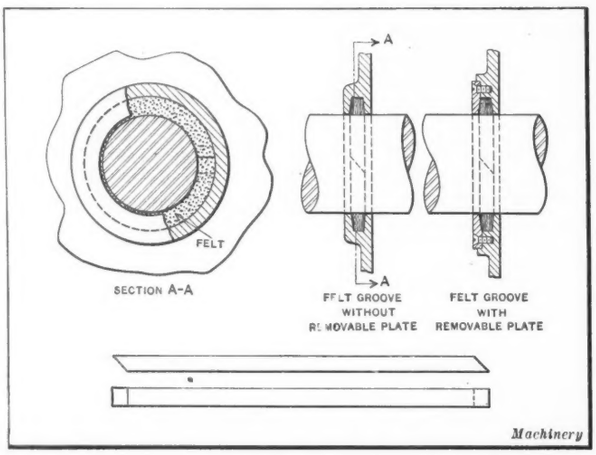


Fig. 6. Diagram illustrating Method of Procedure in making Felt Packing and fitting it into Grooves of Ball Bearing Mounting

Felt Packings for Ball Bearing Mountings

In studying the illustrations of mountings for ball bearings on different types of machine tools and other shop equipment, it will be noticed that in practically every case the caps which fit around the shaft at each end of the mounting are grooved to receive a packing which is used to exclude grit and other forms of dirt from the bearing. When a ball bearing is in operation, the rate at which the balls and races tend to wear is extremely slow until after an appreciable amount of wear has actually developed; but experience has shown conclusively that after the bearing has once started to wear, deterioration is likely to take place very rapidly. Obviously, the presence of grit or other forms of dirt in a bearing will accelerate the tendency for the bearing to wear, and it is on this account that particular care is taken to provide dustproof packings in ball bearing mountings.

When a shaft is rotating, the number of feet per minute at which a point on the surface of the shaft travels is governed by the diameter of the shaft and the number of revolutions per minute at which it runs. By holding either the angular speed or the diameter constant and changing the other variable, it at once becomes apparent that an increase of the variable factor will result in increasing the linear speed of travel of the surface of the shaft. The size of felt packing used in mountings for ball bearings is governed by the linear speed of travel of the shaft, because the higher the speed, the larger must be the packing, in order to prevent its rapid destruction. In determining the required size of the felt packing, consideration must be given to both the diameter of the shaft and the number of revolutions per minute. The S K F Ball Bearing Co., of Hartford, Conn., has made a careful investigation of this subject, as a result of which five standard sizes of felt packings have been adopted which are suitable for use in grooves of specified sizes.

In Fig. 4 are shown the standard groove and felt sizes which have been adopted, and a chart is presented in Fig. 5 which is used in determining the proper size for the groove and felt packing which are required for any given conditions of shaft diameter and speed of rotation for which a ball bearing mounting must be designed. In using this chart, the horizontal line corresponding to a given shaft diameter and the vertical line corresponding to the number of revolutions per minute at which this shaft is to run are located on the chart, and the intersection of these horizontal and vertical lines is then found. The size of the felt packing which is required is determined by the area on the chart in which this point of intersection lies. For instance, suppose it is required to have a shaft 2 inches in diameter rotate at 2100 revolutions per minute. The horizontal and vertical lines through 2 inches and 2100 revolutions per minute are located in the area which indicates that a No. 2 felt packing is necessary to fulfill the requirements of this service. The dimensions of the required felt packing and groove are found from the diagram reproduced in Fig. 4.

In making these packings, it is very important to use a suitable grade of felt, as the material must be of g o o d quality and compact structure in order to stand up satisfactorily under the c o n d i t i o n s of service to which it is subjected. It is also important to make each of the packings in the form of an endless ring in order to avoid possibility of dirt finding its way into the bearing at the point where the ends of the felt are joined. After cutting off a piece of the required length, the ends are cut off at an angle, so that they can be sewed together and form a close-fitting joint with the felt packing of uniform size at the joint. It is also important for the joint to be in a plane perpendicular to the axis of the shaft and not parallel to the axis. The reason for this is quite obvious, as with the joint in a plane parallel to the axis of the shaft, it would be easier for dirt to find its way through the joint and into the bearings. The method of splicing the ends of the felt packing, and the proper position for the packing in the housing are shown in Fig. 6.

Application of Ball Bearings in Machine Tools

The application of ball bearings in motor cars has demonstrated their ability to save power and to operate under severe conditions of service with very little wear. Machine tool builders were not slow to realize the possible advantages to be secured through the application of bearings of this type in the machines which they manufacture. One of the earliest applications was for supporting the thrust load on drilling machine spindles, but subsequently ball bearings have been used in many other types of machine tools. It is generally conceded that for supporting driving shafts in machinery, and for use in countershafts and lineshaft hangers, ball bearings are the means of effecting a substantial saving in power, and about the only reason why they are not generally used in these cases is that some machinery builders and shop superintendents still have to be convinced that the additional expense of ball bearings would be offset by the saving of power.

Conditions Required in Machine Tool Spindle Bearings

About the only point on machine tools where there is a considerable difference of opinion in regard to the desirability

of using ball bearings is for supporting the main spindle. Designers of machine tools are faced with the necessity of fulfilling two sets of conditions in the spindle bearings, which at first sight appear to be diametrically opposed to each other. In order to maintain the desired degree of accuracy in the work, it is necessary for the fit of the bearings that carry the spindle to be as nearly free from vibration and lost motion as it is possible to make it, but to obtain a satisfactory degree of efficiency in the transmission of power, the bearings must also be a free running fit. The service required of these bearings is exceptionally severe, owing to the fact that the loads are subject to sudden changes of magnitude and of the direction in which they are applied. At first sight, it may appear that these two sets of conditions are entirely incompatible, but experience has shown that there are several ways in which the desired combination of conditions may be secured. One method which has been found to give satisfactory results is to use ball bearings for supporting shafts and spindles. Owing to the conditions under which these bearings operate, which have been described in an earlier paragraph, frictional resistance is practically eliminated, and in the case of properly made bearings, the amount of wear is a negligible quantity, so that lost motion will not result in inaccuracy of the work produced on machine tools equipped with ball bearings.

Use of Ball Bearings for Carrying Machine Tool Spindles

During recent years, there has been some controversy between different designers and builders of machine tools concerning the desirability of supporting machine tool spindles in ball bearings, if it is required to obtain accurate work from the machine. It is generally conceded that the use of ball bearings is the means of effecting a substantial increase in transmission efficiency with a corresponding reduction in consumption of power; but those who are not in favor of the use of ball bearings in place of the standard tapered bronze boxes with provision to compensate for wear claim that, after they have been in use for a short time, ball bearings develop a slight amount of lost motion. In order to substantiate the accuracy of this contention, the claim is made that even if the proper size of ball bearing is selected for the service required of it, and granting that this bearing is a perfectly tight fit at the time it leaves the ball bearing manufacturer's plant, lost motion will develop shortly after the bearing has been placed in service. Those who argue along this line state that it in no way contradicts the claim made by the manufacturers that bearings of this type will run for years without showing any sign of wear. The claim made is that, at the time the bearing is new, the surface of the balls and of the inner and outer races are covered with a multitude of very fine scratches left by the abrasives with which these surfaces were ground, and that, when the bearing is started to run under load, it results in these scratches being rolled down to produce a smooth bearing surface, which is highly efficient as regards its freedom from friction, although this improvement in the bearing surface is attained at the expense of a slight amount of lost motion in the bearing. To overcome this criticism, ball bearings used to carry machine tool spindles should be of a type which makes it possible to so design the mountings for the bearings that means are provided to compensate for the slight amount of lost motion which develops shortly after the bearing is placed in service. Some ball bearing manufacturers state that the slight roughness referred to above does not exist when the grinding is properly performed and is followed by polishing.

The use of ball bearings for carrying machine tool spindles is a relatively recent development, and, as in the case of practically all departures from well-established practices of machine design, it is quite natural to expect that many designers will claim that it is impossible to find a satisfactory substitute for the tapered bronze bearing box which is used in a great majority of bearings for machine tool spindles. Despite this fact, there are a number of machinery builders who are now mounting spindles in ball bearings and claim that perfectly satisfactory results are being obtained. It is the contention of these men that, to obtain satisfactory results from ball bearings in this class of service, certain precautions must be taken, the observances of which determine the success or failure of the design. Probably the best way of discussing this matter will be to show typical applications of ball bearings in machine tools and explain methods of mounting which different manufacturers have found to be satisfactory.

The preceding discussion has been concerned with outlining the basic principles which must be observed in the design of mountings for ball bearings, and the methods of lubricating the bearings in order to reduce frictional resistance and protect the balls and raceways from rust. The second installment of the article, which will be published in September, will describe the methods used by representative machine tool builders in applying ball bearings in their machines.

* * *

OBTAINING GOOD RESULTS IN TAPPING[1]

In order to obtain satisfactory results in tapping, it is first necessary to obtain good taps and dies that are properly designed for the work to be done, and that have been accurately machined, carefully hardened, inspected, and tested. In all cases great care should be taken to bring the tap into as nearly perfect alignment with the hole as possible. If the machine is out of alignment it should be corrected, and in no case should a floating holder be used simply to compensate for any error in alignment. Good results can be obtained by holding the tap in a telescopic holder, but the friction between its sliding surfaces should be kept as low as possible; also it should have a minimum amount of lateral float. The holes to be tapped should be large enough to prevent any binding or excess friction, and care should be taken to see that they are drilled deep enough to prevent the tap from coming into contact with the bottom, or with chips resting on the bottom of the hole. The cutting edges of taps should be kept sharp; as much attention should be given to them as to the cutting edges of any other tool. The proper lubricant should be used, and a good supply forced, or allowed to flow, over the tap while tapping. The kind of lubricant adapted to any particular work should be determined by experiment.

The most efficient speed should also be determined by experiment, and this speed should then be maintained. In many cases too low spindle speeds are responsible for inferior threads and a high percentage of tap breakage. Starting or reversing should be accomplished with as little shock as possible to the tap. The tap should be guided forward and back again as nearly as possible at the same speed as that with which the tap feeds forward or back in the work. A long bar of stock that is bent should not be put in a machine, as the shaking resulting from this practice causes breakage of taps, inferior threads, and rapid wearing of the machine bearings.

To obtain the highest efficiency, tapping should be accomplished by a separate operation. This avoids the necessity of delaying turning or boring operations while making repairs or adjustments for the tapping operation. In this way, more accurate threads can be produced and there will be a minimum of spoilt work and tap breakage.

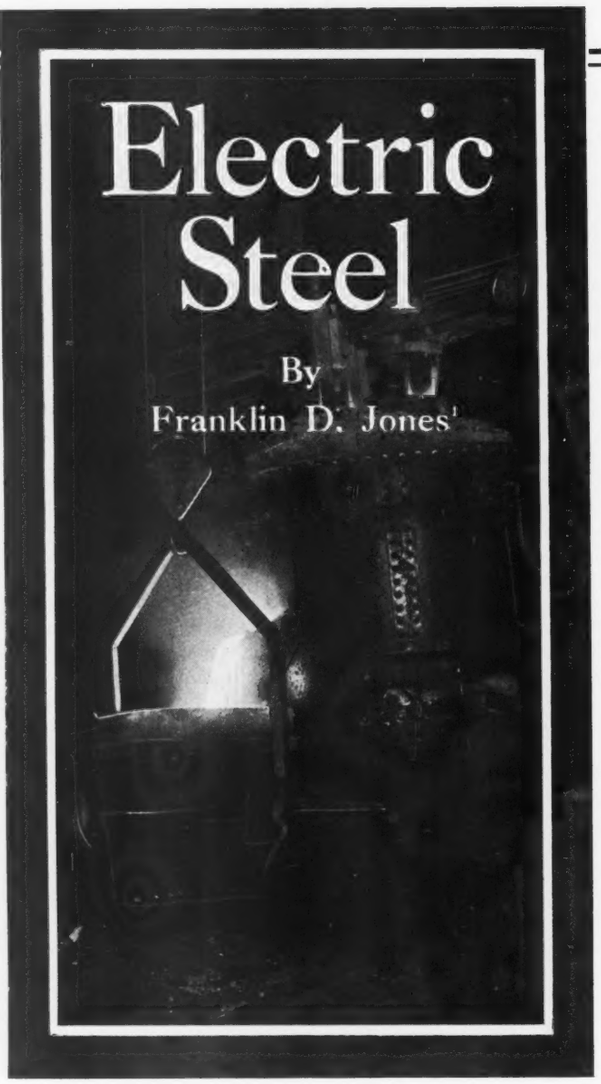
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Machinery may be badly damaged by being hauled from the railway depot to the plant by inexperienced teamsters, but as this damage may not be discovered until the plant is in operation, it will very likely be charged against the manufacturer as a defect in construction. Recently, some large air compressors were loaded upon the wagon in such a way that the stress of the shocks from the wheels was carried by bolts in the lining of the cylinder that separated the water jacket from the compressor chamber, with the result that the bolts were strained and a joint was opened. The cause of the leak, however, was known in this case, for an engineer had noticed the compressor on the dray and had called attention to the faulty loading, predicting the damage that was later found.

[1] Summary of a paper read by Harry E. Harris, president of the H. E. Harris Engineering Co., Bridgeport, Conn., before the Connecticut Section of the American Society of Mechanical Engineers at Bridgeport, Conn.

Electric Steel

By Franklin D. Jones[1]



WHILE electric steel or steel made in the electric furnace is not a new product, the expansion of this branch of the steel industry has been so rapid, especially since the beginning of the war, that users of steel as well as steel-makers are naturally interested in the reasons for this rapid growth and the trend of its development. In 1908 there was only one furnace in the United States producing electric steel and the output for the year was only about 55 tons. The number of electric furnaces installed in the United States on January 1, 1918, was 233 and many new installations have been made during the past six months. The estimated tonnage for electric steel during 1917 varies greatly and ranges from about 235,000 tons up to one million tons. Whatever the tonnage, it is certain that the electric steel industry, which a few years ago was in the experimental stage, is now on a firm commercial basis.

Early experiments in the production of electric steel were made by Sir William Siemens, who constructed a small arc furnace in 1878. Twenty years elapsed, however, before the Stassano furnace, which was the first to operate commercially, was introduced. The use of electric furnaces would doubtless have increased more rapidly after the introduction of this process had it not been for the relatively high cost of generating electrical energy at that time. The wonderful advancement made in both the generation and distribution of electricity during recent years, combined with the advantages of the electric furnace for certain melting and refining processes, has resulted in the rapid development of this method of producing steel.

Application of Electric Furnaces in Steel Industry

Electric furnaces are adapted primarily for melting and refining processes, and they probably will never be able to compete with the blast furnace for smelting ore except under certain favorable conditions. What might be defined as "an electric blast furnace," was developed in Sweden in 1910. This furnace is similar in principle to an ordinary blast furnace, except that it is provided with three electrodes which take the place of the tuyeres. The furnace operates without an air blast, and either charcoal or coke is used for melting the charge of iron ore. The charge is fed into the top of the furnace in the usual way. The use of the electric furnace for smelting iron ores is evidently limited to localities where hydro-electric installations and cheap electrical power are available. One electric furnace which has been installed in the United States and is used for smelting has a rectangular steel shell lined with a refractory material and a sloping bottom to facilitate the flow of the molten metal. Five stacks which extend above the roof of the furnace are used for charging and graphite electrodes are located between these stacks. The furnace is charged at regular intervals and its operation is continuous.

The important applications of electric furnaces in the steel industry are for making special alloy steels, tool steel (including ordinary carbon steel and high-speed steel), for melting the steel used in making steel castings, and for melting the ferro-alloys which are added to "special steels" to secure different chemical and physical properties. Most of the ferro-alloys used in the United States prior to the war were imported, but, at the present time, large quantities of the alloys used in producing high-speed and special steels are manufactured in this country. These alloys include ferro-silicon, ferro-chrome, ferro-nickel, ferro-tungsten, ferro-manganese, ferro-vanadium, etc. The electric furnace has also been used to some extent for refining cast iron in the foundry instead of using a cupola, and also low-phosphorus pig iron and "washed metal." "Washed metal" is pig iron from which most of the silicon and phosphorus have been removed, and it is used for making special low-phosphorus steel.

Most of the electric steel produced is used either for making special alloy steels or tool steel, although the electric furnace is used extensively in steel foundries. No accurate data are available as to the amount of tool steel made electrically compared with the output of the crucible process. Some steel-makers and metallurgists contend that the electric furnace not only produces much more tool steel at the present time than the crucible process, but that ultimately it will be used almost exclusively for tool steel production. Others connected with the steel industry believe that there will continue to be a field for both the electric and crucible processes and that the electric furnace is adapted more especially for the production of special alloy steels for use in the construction of automobiles, airplanes, ordnance, etc. Steel may be produced in the electric furnace which is undoubtedly equal to crucible steel in quality, if not superior, and it is claimed that the electric process is

In view of the fact that the use of electric furnaces in steel foundries and for producing special alloy and carbon tool steels has increased very rapidly since the beginning of the war, the general application of the electrical process and its advantages, dealt with in this article, are of timely interest. The article also describes the various types of furnaces in common use and the methods of operating them either independently or in conjunction with the more common refining processes.

[1]Associate Editor of MACHINERY.

more economical, especially at the present time, on account of the cost of crucibles.

There is a decided difference of opinion regarding the present and future use of the electric furnace in preference to the open-hearth furnace. Even though the cost of electric steel is higher than open-hearth steel, the greater degree of refinement and closer regulation that is possible with the electric furnace offset this difference of cost for the finer grades of steel. In steel foundry practice, it is claimed that an equivalent tonnage of high-grade electric steel can be produced at an average lower cost than the ordinary commercial grades of open-hearth steel, since the charge of the electric furnace may consist entirely of old scrap which is cheaper than the combined scrap and pig iron required with the other process. One of the striking features of the electric furnace development is the size of the installations. A great many plants are now equipped with furnaces having a capacity of five or six tons, but ten, fifteen, and twenty-five ton sizes are in use. The United States leads at present in the number of electric furnaces in operation and Great Britain occupies second place. The world's largest single center of electric steel production, however, is in Sheffield, England.

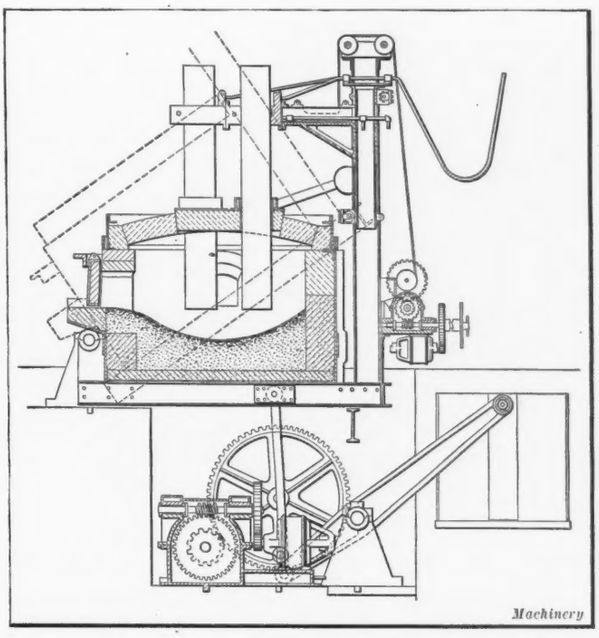


Fig. 1. Small Heroult Furnace and its Electrically Operated Tilting Mechanism

General Classes of Electric Furnaces

Electric furnaces are used either for melting and refining metals, or for heating them to some temperature below the melting point, as in connection with the heat-treatment of steel. The three general types in use may be classified electrically as arc furnaces, resistance furnaces, and induction furnaces. With each type, the heat is derived from electrical resistance, but the nature or form of the resistance varies in the different general classes of furnaces mentioned. The arc furnace, which is the most important type in the steel industry, is equipped with electrodes, the current passing from one electrode to another. These furnaces differ in regard to the arrangement and number of the electrodes, as explained later. The arc furnace is used almost exclusively in the production of electric steel.

While all electrical furnaces depend upon electrical resistance, the general type in which heat is generated by the passage of a current either through the charge or through a resistor forming part of the furnace is classified as a resistance type to distinguish it from the others. Some of these resistance furnaces are so arranged that electrodes come into contact with the charge and the latter forms the resistance. This is the direct resistance class. Another type has a resistor which surrounds the furnace crucible and heats it by direct radiation, and there is a third class in which the heat generated in the graphitic or other resistor is radiated to the walls of the furnace and is then reflected onto the charge. Resistance furnaces in general are used principally for heat-treating, annealing, and for melting non-ferrous metals.

With the induction type of furnace, the heat is generated in the metallic charge by means of induced currents. This type is similar in principle to a static transformer, the material heated corresponding to the low tension winding. Thus, the induction furnace may be defined as an electrical apparatus which contains within itself the transformer that induces the heat in the charge, whereas the arc furnace is practically a hearth which holds the charge, and the arc is the source of heat, serving the same purpose as the flame in an open-hearth furnace. The first induction furnace for steel melting was developed by Kjellin, in Sweden, about 1900. The primary winding of a Kjellin type surrounds the core and is within a cylinder made of refractory material and cooled either by circulating water or a forced draft. The annular shaped hearth containing molten metal is beyond the windings and acts as a single turn of the secondary winding; consequently, when current flows through the primary winding, a current is induced in the bath of metal which is thereby heated, practically all of the electrical energy being converted into heat. Induction furnaces are used very little in steel plants, but are applied principally in melting non-ferrous metals.

Methods of Operating Electric Furnaces

Electric furnaces may either melt a cold charge or they may receive the metal in a molten condition. Most of the electric furnaces now in use are for cold melting, but the larger sizes are commonly arranged to use molten charges. After the introduction of the electric furnace, steel manufacturers soon recognized that it might be used to advantage in conjunction with the Bessemer converter and open-hearth furnace, following the plan of the well-known "duplex process" by which the metal is partly purified in a Bessemer converter and is then further refined in the open-hearth furnace. In fact, the first electric furnace installation in the United States consisted of an open-hearth furnace for preliminary melting and refining, and an electric furnace which received the molten metal for deoxidizing and desulphurizing it and for making whatever additions or changes might be necessary to secure the desired analysis. This is often called the "hot metal process." Both Bessemer converters and open-hearth furnaces are also used in conjunction with the electric furnace. The Bessemer converter is used for decarbonizing and desiliconizing the metal; the open-hearth furnace is then used for dephosphorizing it, and the refining process

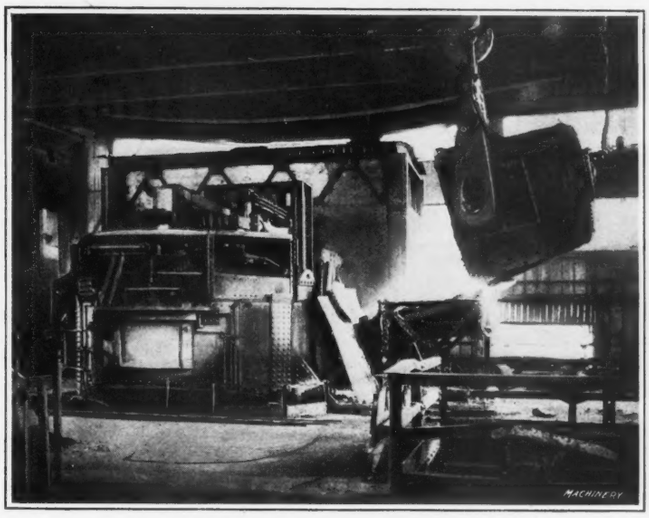


Fig. 2. Twenty-five-ton Heroult Furnace receiving Charge of Molten Metal

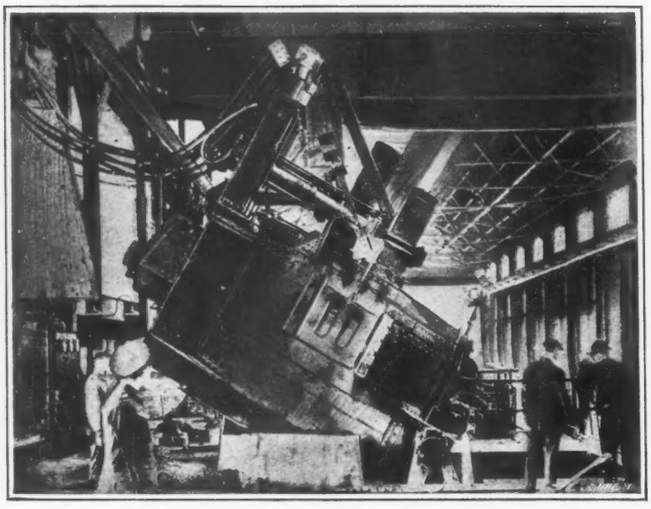


Fig. 3. Twenty-five-ton Heroult Furnace in Pouring Position

is then completed by deoxidizing and desulphurizing in the electric furnace. One installation operating on the triplex system consists of ten electric furnaces having a nominal capacity of 25 tons each, two 25-ton open-hearth furnaces, and two 25-ton Bessemer converters, the three processes being used in tandem. The metal is first "blown" in the Bessemer converter. Then it is transferred to the open-hearth furnaces and finally to the electric furnaces. The estimated capacity of this plant is 50,000 tons of electric furnace steel per month.

Electric furnaces may either be basic or acid, but a large percentage are lined for basic operation. The basic furnace permits the use of a basic slag which serves to remove impurities from the metal, just as in the basic open-hearth furnace. Thus phosphorus, sulphur, and oxygen may be removed, which permits using relatively cheap raw materials. With the acid process, no phosphorus or sulphur is removed, and if these elements are to be held within narrow limits, the materials composing the charge must be carefully selected.

Advantages of Electric Process

The steel produced in the electric furnace may be chemically purer than that made by any other process, although it does not necessarily follow that electric steel has superior physical qualities simply because it is pure chemically. Inferior grades of steel may be produced in the electric furnace, and the extremely high temperatures obtained from the electric arc are often referred to as the principal cause of poor electric steel. The fact remains, however, that the electric furnace when properly designed and used is capable of producing steel which chemically or physically is unexcelled. One advantage of the electric furnaces is that they permit of closer control of the composition of steel than any other process, which accounts for their use, for instance, in preference to the open-hearth furnace in the production of special alloy steels. In the electric furnace, since the heat is obtained from the electric current and no fuel is burned, there are no impurities introduced from the gases of combustion; in fact, fusion may be effected in a neutral or reducing atmosphere. Less excess alloy needs to be added to the heat in an electric furnace to insure the proper amount in the finished steel. Some steel-makers claim that it is necessary to use only one-half the amount of ferro-manganese that would be required with the best open-hearth practice. Another point in favor of the electric furnace is that the alloy additions for making alloy steels may be made in the furnace itself, rather than in the ladle, thus insuring thorough assimilation, diffusion, and a more homogeneous product.

Accurate control of the composition of electric steel tends to make the results of heat-treatment more certain, and it may be subjected to a higher degree of heat without injury in forging or in connection with heat-treatment than is the case with other steels. The electric furnace also has an advantage in that it may be used in recovering alloy scrap, which, in some cases, is not desirable to include in the charge of an open-hearth furnace. Furthermore, when alloy scrap is used in an open-hearth furnace, a large proportion of the alloy metal is lost in the slag. It is practicable to use relatively cheap raw materials in the electric furnace and to convert them into high-grade steel, which can be deoxidized and desulphurized almost completely. The phosphorus and sulphur may not exceed 0.010 per cent, and in carbon steel the average sulphur content is lower, whereas, in alloy steels, the sulphur barely exceeds 0.015 per cent.

Tests of electric and open-hearth steels each having a carbon content of 0.12 per cent showed the following physical properties: Ultimate strength of open-hearth steel, 56,500 pounds per square inch; elongation in two inches, 29.82 per cent; ultimate strength of electric steel, 65,200 pounds per square inch; elongation in two inches, 26.05 per cent. When the carbon content was increased in each case to 0.20 per cent, the ultimate strength of the open-hearth steel was 58,320 pounds per square inch; and the elongation in two inches, 28.35 per cent. The ultimate strength of the electric steel was 73,150 pounds per square inch, and the elongation in two inches, 22.75 per cent.

Types of Arc Furnaces Used in Steel Industry

Since the arc furnace is used almost exclusively in the steel industry, only this general type will be considered. All arc furnaces may be divided into two classes, first, the arc-radiation class and, second, the arc-resistance or arc-conduction class. Furnaces of the second class may belong either to the short-arc type or the long-arc type. The Stassano furnace, which was the first commercial design, heated the metal almost entirely by radiation from the electric arc and belongs to the arc-radiation class. The arc-resistance type is so arranged that heat is generated by the arc and by the passage of current through the charge. The current may either pass along the surface of the charge to the other electrodes or through the body of the charge.

The arc furnace may use either direct or alternating current, the latter being used largely, since this is the current supplied by most power companies. The three-phase current is employed more than the two-phase or single-phase. The voltage depends upon the length of the arc, as the latter is a form of electrical resistance. Whatever voltage is required for melting or heating is obtained by transformers at the

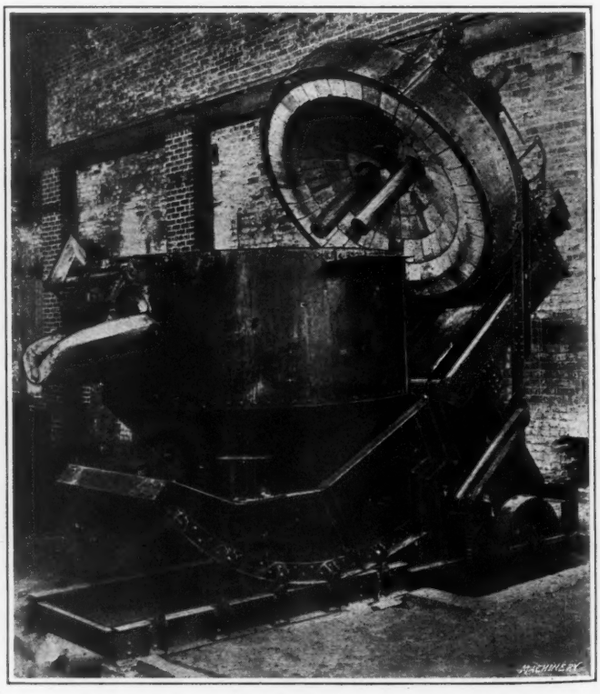


Fig. 4. Five-ton Snyder Furnace with Roof tilted back for Charging

furnace, so that the transmission voltage may be of any value. The usual potential between electrodes is about 100 volts.

Heroult Electric Furnace

The Heroult furnace, which is now used more than any other type, belongs to the arc-resistance class. The electrodes are placed above the bath and the current passes from one electrode to the metal and from the metal to the next electrode. In this way, the bath is heated both by the heat radiated from the arc and by the heat produced by the resistance of the steel and the slag to the passage of the current through them. Fig. 1 shows a sectional view of a three-phase Heroult furnace and its electrically operated tilting mechanism. The three electrodes extend down through the roof of the furnace and are so located that lines joining their centers form a triangle. The steel shell of the furnace is lined with a refractory material, the exact nature of which depends upon whether the furnace is to be basic or acid in its operation. The three electrodes are connected with the transformers by flexible cables which permit the furnace to be tilted while pouring the charge. The furnace shown in Fig. 1 is so arranged that it tilts about a hinge located just below the spout so that the latter remains nearly stationary while pouring. The dotted lines indicate the pouring position. Power for tilting the furnace is derived from a motor which transmits motion to a large gear wheel through a combination of spur and worm gearing. This gear wheel is connected directly with the furnace by means of rods, as the illustration shows. One advantage of this arrangement is that, if the operator fails to stop the motor, the furnace will simply descend to its original position; moreover, when the furnace is either at the upper or lower positions of the stroke, it will move in the desired direction, no matter which way the controller is operated. The weight of the furnace is balanced by a counterweight which connects by means of levers.

The 25-ton Heroult furnace illustrated in Figs. 2 and 3 is the largest size in use at the present time. Fig. 2 shows a charge of molten metal being poured from the ladle into the furnace, and Fig. 3 shows the furnace tilted and the refined charge being poured.

Snyder Electric Furnace

The Snyder electric furnace belongs to the arc-resistance class and is a long-arc type. The electric current may be either single-phase, two- or three-phase, or direct-current, but the latter is not commonly used. The single-phase or direct-current furnaces have two electrical connections, whereas the two- or three-phase furnaces have three or more, according to the type. The three-phase furnace has two of the phases connected to the movable carbon electrodes at the top, while the third is connected to a metal contact at the bottom of the furnace. The Snyder furnace is doorless, and the entire roof of the furnace is tilted back for charging, as shown in Fig. 4. After the charge has been dropped into the furnace, the roof is pulled forward by a motor and sealed with a dry fireclay gasket. The electrodes may be either hand or motor-operated, an automatic regulator being applied in the case of motor operation. An advantage claimed for the long arc is that it minimizes the necessity of moving the electrodes. The opening roof feature also reduces the time for charging, since machinery can be used instead of shovels. These furnaces are arranged in three different ways to meet the pouring requirements under different conditions. With the rocking type illustrated in Fig. 4, which is the most common, the end of the spout moves forward and down as the furnace is tilted to the pouring position. This type is recommended when it is relatively easy to move the ladle to correspond with the movement of the spout. The second or "heaving" type has a circular shaped rocker underneath the furnace which is so located that the spout remains practically stationary as the furnace is tilted. This arrangement is especially adapted for hand ladle work. With the third or "dumping" type, the spout moves down and backward. This type is ordinarily preferred for small installations in which it is easy to follow the spout with hand ladles.

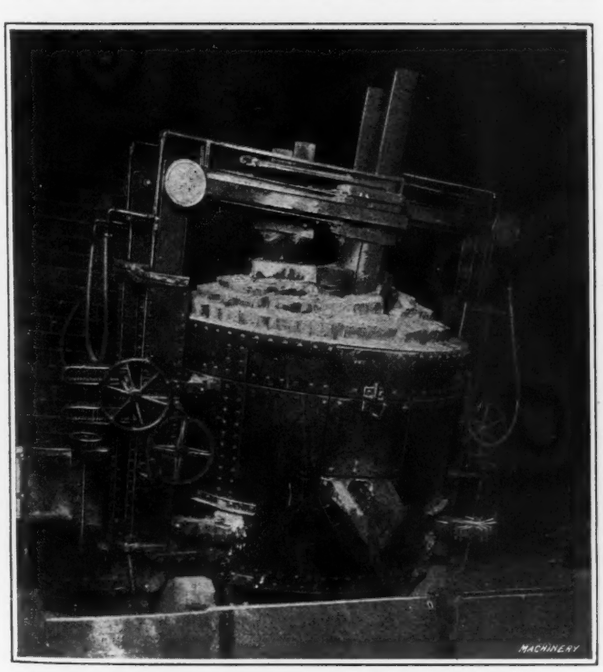


Fig. 5. Booth-Hall Furnace of Four-ton Capacity

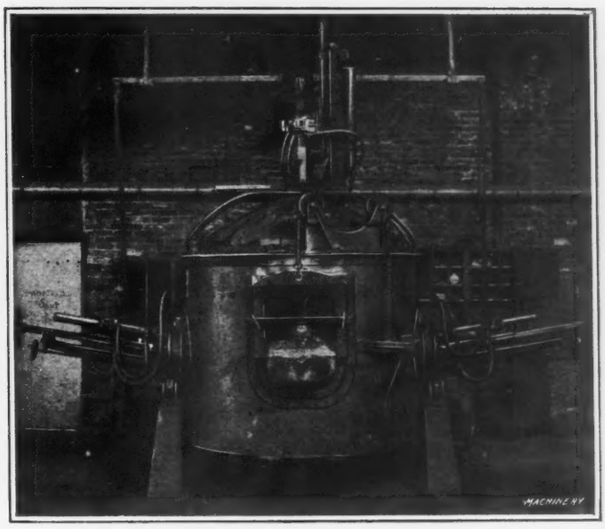


Fig. 6. Front View of One-ton Rennerfelt Furnace

Rennerfelt Electric Furnace

The Rennerfelt electric furnace operates with a free-burning are like the Stassano furnace, but differs from the latter in the way the arc is formed. A cross-sectional view of a three gross-ton size is shown in Fig. 7. There are three electrodes, a vertical electrode being placed between two which are shown in a horizontal position but may be tilted, as explained later.

The vertical electrode carries about 40 per cent more current than the others, so that the arc is thrown downward toward the bath and away from the roof of the furnace. The three-phase current, which may be of any voltage and frequency, is transformed to a two-phase three-wire system. The two side electrodes are connected to the terminal of each phase, and the top one is connected to the middle conductor. The power input is regulated by moving the side electrodes in or out, thus changing the length of the arc. This adjustment may be effected by hand or by electric motors controlled either automatically or by means of push-buttons. The top electrode has to be moved downward perhaps once an hour, depending upon its consumption. When charging the furnace, the side electrodes are tilted upward, thus leaving sufficient space beneath for inserting the whole charge at one time. As the charge melts, the electrode ends are continually lowered, thus keeping the flame about two or three inches over the bath. A one-ton Rennerfelt furnace is shown in Fig. 6. The

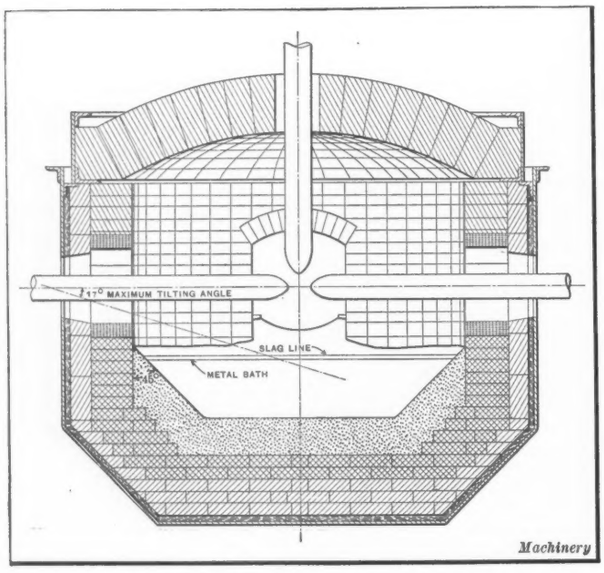


Fig. 7. Sectional View illustrating Arrangement of Electrodes on Rennerfelt Furnace

electrodes at the sides and their holders, and the upper vertical electrode, may be seen in this illustration. These furnaces are provided with trunnions resting on roller bearings supported by frames at the sides and they are tilted either by hand or by motor, depending upon the size. The furnaces with a capacity up to one ton have only one working door which is used both for charging and pouring; the larger furnaces have one charging and one pouring door.

Booth-Hall Electric Furnace

The Booth-Hall furnace, shown in Fig. 5, is so arranged that power is introduced through one, two, or three main vertical electrodes, the number depending upon whether the furnace is to operate single-phase, two-phase, or three-phase. The furnace also has an auxiliary electrode and wrought-iron grids which are imbedded in a hearth with a refractory facing. The auxiliary electrode is inserted vertically through the roof, except in small furnaces, in which case it is inserted obliquely through the door opening. The two-phase furnace is considered preferable for the usual power supply and steel refining conditions, and the following description applies particularly to this class.

When starting a heat in a two-phase furnace with a cold charge, a pawl on the auxiliary electrode holder is released, permitting the electrode to rest upon the scrap charge. Arcs are then drawn with the two main electrodes and the metal begins to melt under these arcs. The auxiliary electrode acts as a common neutral or return, no arc being drawn, and consequently no melting occurs under the auxiliary electrode. When enough molten metal has accumulated on the hearth to make the latter a conductor of electricity, the current begins to flow through the wrought-iron grids. The auxiliary electrode is then withdrawn from the furnace entirely, and the opening for it is closed. The furnace then continues to operate, the current passing through the main vertical electrodes, the bath, and the hearth, and out through the grids. The transformer connections are so arranged that each of the two phases has an independent circuit. The arcs are governed by automatic electrode regulators for maintaining a uniform power input into the furnace and a balanced load on the lines.

Since there are only two electrodes entering the roof of a two-phase furnace except at the beginning of a heat, it is claimed that the furnace has a relatively low radiation loss, less electrode breakage and electrode consumption, as well as a lower initial cost for the furnace equipment, as compared with types having three or four main electrodes. The possibility of failure to secure contact when starting a heat is said to be eliminated by the use of the auxiliary electrode. The two main electrodes and the auxiliary electrode acting as a common neutral make it possible to use the arcs for sintering in the hearth of the furnace layer by layer, thus forming a monolithic mass that is durable. All the tilting and electrode regulating mechanism is below the floor and is completely covered. Furnaces ranging from 2½ to 6 tons capacity are built two-phase, since in practically all localities a single-phase load for such furnaces would not be acceptable to power companies. For refining steel, the two-phase furnace is recommended, except in 8- and 10-ton sizes, in which case the three-phase type is regarded as more practicable. Furnaces up to 1½ ton holding capacity intended for the straight melting of scrap are made single-phase, unless power conditions are such that a single-phase load is not acceptable.

Ludlum Electric Furnace

The Ludlum electric furnace is of ellipsoidal form, and it has three electrodes which extend down through the roof. These electrodes instead of being located in triangular formation are in a straight line corresponding to the center line of the furnace, as may be seen in Fig. 8, which shows a ten-ton furnace in the pouring position. The electrodes are held by bronze arms projecting from beams attached to the furnace structure. These arms may be raised and lowered by automatic control or by handwheels. There are no bottom connections. The shape of the furnace is such that there are no straight side walls nor overhanging walls with the furnace in any working position. There is a door at each end but no spout. The furnace can be charged from both ends at once, and it is tilted by an electric motor to pour through one of the doors.

The furnace is filled with the charge of scrap to be melted, and at first the electrodes rest on the charge so that soon after the current is turned on the electrodes melt their way through nearly to the bottom. By this time, a pool of molten metal has formed beneath the electrodes because the deepest part of the hearth is directly below them. The charge is melted from the bottom up, the arcs remaining covered by the scrap until the latter is completely melted, so that the roof is not exposed to the high temperature radiating from an open arc. The roof of this furnace is in the form of a low arch and, in practice, an extra roof is built on a separate frame, so that the old one can readily be replaced at any time. For basic operation, the hearth is lined with magnesite brick to a thickness of nine inches or more.

Greaves-Etchells Electric Furnace

The Greaves-Etchells furnace, shown in Figs. 9 and 10, has two of the phases connected to the two electrodes above the bath while the third phase is connected to a copper plate which extends over the bottom of the furnace. The cur-

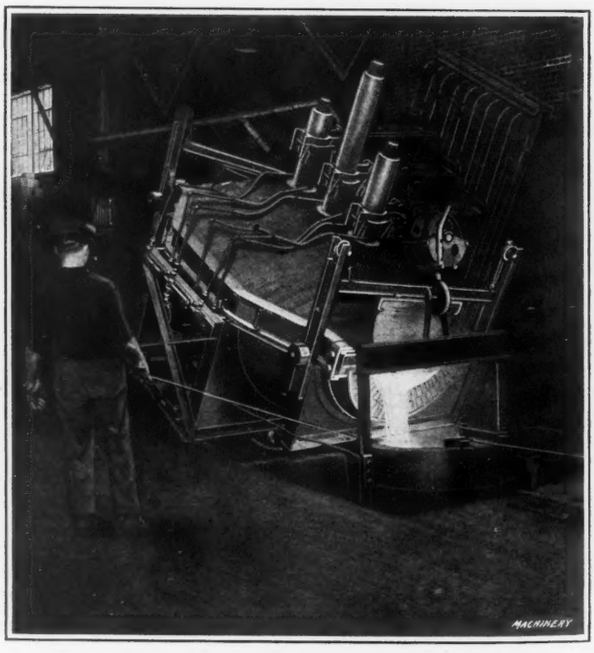


Fig. 8. Ten-ton Ludlum Furnace in Pouring Position

rent flowing through the hearth generates considerable heat below the bath and the electric arcs above the charge maintain the slag and surface at the desired temperature. Convexion currents in the metal resulting from the bottom heating cause a continuous circulation of the metal and uniform heating. The hearth lining, which is at least 20 inches thick, is made of dolomite, magnesite, and other materials, in such a way that the electrical resistance is high at the inside of the bath in proximity to the charge and decreases rapidly to a negligible quantity at the outside. The system of transformer ratios is arranged to give a balanced condition when the upper electrodes are in equal adjustment. The equipment has been designed to withstand any short-circuiting of the electrodes which may occur during the melting process when pieces of scrap fall against the electrodes. The transformer connections are such that the short-circuit current of one electrode must traverse two transformers in series and in different phase, which automatically lowers the power factor momentarily and also has a strong buffer effect; the permanent resistance in the path of the current through the hearth also limits the effect of short circuits. The raising or lowering of the electrodes for regulating the energy supplied by the furnace may be effected by automatic regulators or by hand control. The voltages across the arcs may also be varied in all except the smallest size of furnace, and the ratio of heat generated above and below the bath may be regulated over a wide range. The tilting mechanism is so arranged that the spout travels downward in a vertical line when pouring.

Girod Electric Furnace

The Girod electric furnace is an arc-conduction type of the class having bottom connections. The current is supplied by one or more carbon electrodes *A*, Fig. 11, which extend vertically through the furnace roof. The lower ends of these electrodes are near the level of the slag as in other furnaces. In the bottom of the furnace and as far as possible from the upper carbon electrodes, there are six or more steel electrodes *B* which pass through the refractory bottom and are in direct connection with the furnace shell and the low-tension side of the power plant. With this arrangement, the current is forced to pass through the charge, the object being to obtain a more uniform heat than when the arc is formed above the charge or passes through the upper surface. Another advantage claimed for the Girod furnace is that the current passing through the bath produces an electromagnetic field which gives the bath a rotary movement and accelerates chemical reaction.

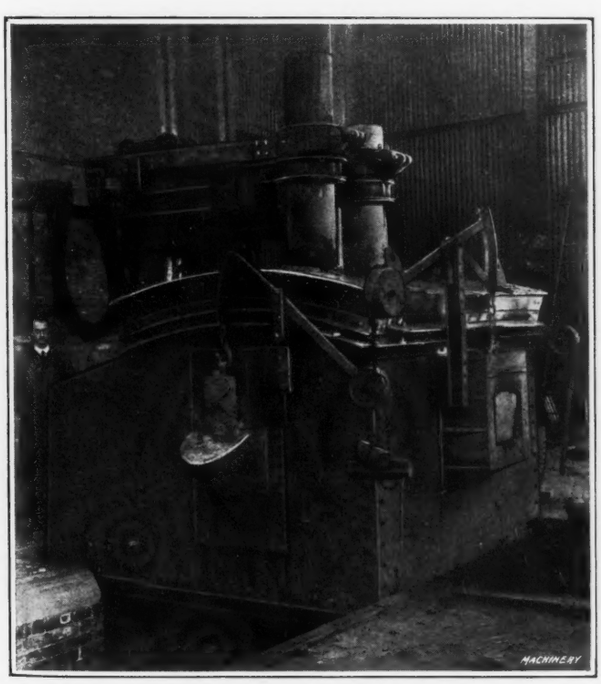


Fig. 9. Three-ton Greaves-Etchells Furnace

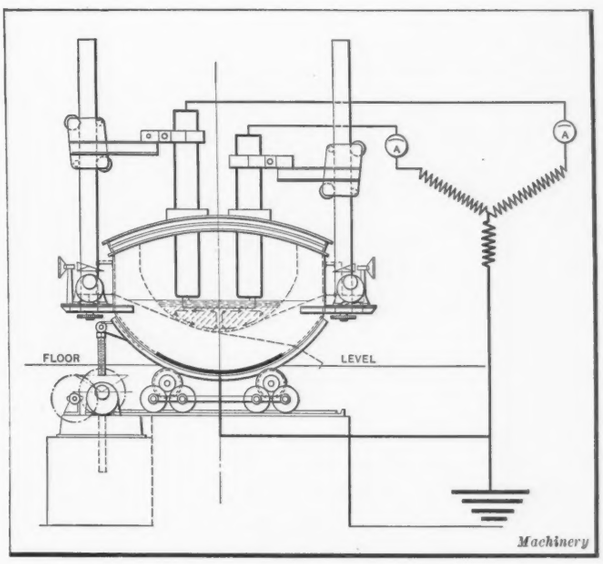


Fig. 10. Diagram illustrating Arrangement of Twelve-ton Greaves-Etchells Furnace

The Girod furnace may be adapted to any system of current, and the usual tension is 65 volts for small furnaces and 70 volts for large ones. The use of single-phase alternating current is considered preferable for furnaces of small capacity. Furnaces up to four tons in capacity are generally single-phase and have one carbon electrode, whereas larger sizes are three-phase and have three carbon electrodes. The use of a single-phase furnace involves, in a three-phase distribution system, the installation of rotary converters or motor generators with transformation losses of about 14 per cent. The three-phase furnace simply requires step-down transformers with energy losses of only 3 or 4 per cent. The connections of a three-phase furnace are arranged to give an equal load on each phase. The furnace is fitted with a sliding door through which the charge is inserted and the slag removed. Opposite the door is the tap hole.

Electrodes for Electric Furnaces and Their Regulation

The electrodes used in electric furnaces for steel melting and refining are made either of amorphous or graphitic carbon. The graphite electrodes are generally used on the long-arc type of furnace, but many short-arc furnaces are provided with amorphous carbon electrodes, because of the "umbrella" effect, since they are twice as large in diameter as the graphite electrodes and afford better protection for the roof against the intense heat radiated directly from the arc. While the electric conductivity of graphite is much higher than that of amorphous carbon, the former is more expensive. The number of electrodes depends upon the kind of current used and whether or not there are electrical connections through the bottom of the furnace. With bottom connections, a single-phase furnace requires one electrode; a two-phase furnace, two electrodes; and a three-phase furnace, three electrodes. If there are no bottom connections and the current either passes from one electrode to the other through the bath or if the electrodes are arranged to maintain the arc above and clear of the bath, then a single-phase furnace requires two electrodes; a two-phase furnace, four electrodes; and a three-phase furnace, three electrodes.

The adjustment of the electrodes to regulate the length of arc and the flow of the current may be effected by hand, but an automatic regulating device is generally employed. Hand regulation involves constant attention on the part of the operator, and is laborious on the large furnaces so that automatic regulation is preferable. The Thury system of regulation as applied to a three-phase furnace, has three regulators, there being one for each electrode. The electrodes are maintained in the desired positions by means of these regulators, in conjunction with the motor-driven electrode adjusting mechanism. The regulators are connected to a motor-driven countershaft, and each regulator is in the form of a double-

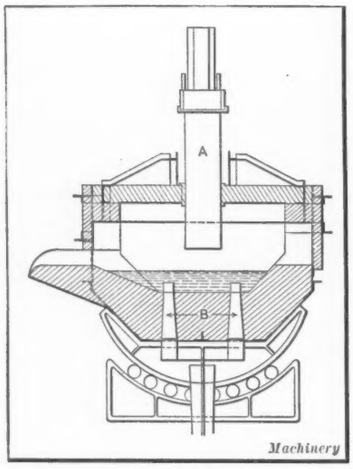


Fig. 11. Diagram showing Arrangement of Electrodes in Girod Furnace

throw switch for rotating the motor in either direction. The operation of this switch is controlled by a solenoid which is energized by current from a series transformer in the main circuit on the high-tension side. The regulating mechanism controlling the switch is held in equilibrium when the flow of the current is normal. Any decided variation in the flow causes the regulator switch to be thrown in whatever direction is required to restore the normal current flow by adjusting the electrodes. The electrode holders should be water-cooled in order to prevent arcing at the connections, although this may not be necessary on very small furnaces.

The automatic electrode control made by the General Electric Co. has a control panel consisting of three sections. On the upper section are located three electrode groups, each consisting of one contactor group and one shunt relay. The shunt relay is connected across the alternating-current circuit, and if the latter is broken or the power fails for any reason, the relay opens the control circuits, thus preventing damage to the furnace and loss of heat. The contactor group consists of one raising contactor, one lowering contactor, and one dynamic breaking contactor, all mechanically interlocked. On the middle section of the panel there is a glass case containing three contact-making ammeters, each controlling one contactor. Below each ammeter there is a dial switch for varying the number of effective turns in the ammeter coil and in this way the amount of power fed to the furnace. (A more recent design is equipped with a rheostat in shunt with the ammeter coil.) On the bottom section of the panel, there are four double-pole single-throw switches. One of these is a totalizing switch for the electrode motors, each motor being controlled by one of the three additional switches. On the back of the panel, three contactors are located for varying the resistance in series with the electrode motors when changing from normal to the emergency conditions, and vice versa.

Electric Furnace Linings

Magnesite and silica are the chief materials used for electric furnace linings. In a basic furnace, the lining of the hearth up to a point a little above the slag line is usually of magnesite, although dolomite may also be used. The furnace wall above the slag line may be lined with silica, magnesia, or chrome brick, the material being selected according to conditions. Silica is used for the roof lining of a basic furnace, and an acid furnace is lined with silica throughout.

The Rennerfelt furnace illustrated in Fig. 7 is lined for basic operation. Firebrick is placed next to the shell, as indicated by the single section lines. The next layer, which extends slightly above the slag line, consists of magnesite bricks (indicated by cross-hatching or double section lines) and an inner fused lining of dead burned magnesite. The side walls from the point where the magnesite bricks end, up to the roof, are lined with silica bricks which are also used for the roof. For acid operation, the bottom of the furnace would be made up of silica bricks with a fused lining of ganister on top, and the walls and roof would be lined with silica brick.

Electric Furnace Current Consumption

The current consumed by an electric furnace per ton of metal refined or melted depends somewhat upon the kind of steel, the degree of refining, the size of the furnace, and the general operating conditions. A furnace melting and refining plain carbon steel may have a current consumption as low as 450 kilowatt-hours per net ton, whereas, in the case of alloy steels, the consumption may vary from 600 to 800 kilowatt-hours. The current consumption is usually larger for the smaller installations and may be 800 or 900 kilowatt-hours for a furnace operating on special steels. When the sulphur and phosphorus contents with a given grade of scrap must be reduced to very low limits, more power is required, because more slag, made principally of lime, must be melted. Electric furnaces melting cold scrap and converting it into tool or alloy steels (using two slags) ordinarily have a current consumption varying from 700 to 800 kilowatt-hours per net ton, whereas, when producing a merchant grade of carbon steel (using one slag), the consumption may not exceed from 500 to 650 kilowatt-hours per ton, the amount depending upon the size of the furnace, the rapidity of the melting, and the grade of the scrap, rusty deoxidized scrap requiring more power. When the charge is not melted in the electric furnace and the latter is used in conjunction with either the Bessemer converter or the open-hearth furnace, the current consumption is relatively low. For instance, furnaces operating on the triplex system have required only 110 kilowatt-hours per ton.

* * *

CONVENIENT SHOP OPERATION SHEET

The accompanying illustration shows a shop operation sheet used by the Rockford Milling Machine Co., which makes it possible to keep a convenient record of all the information required in connection with the manufacture of parts. It will be noted that on this sheet the operation, type and size of machine, tools, fixtures, and gages used, speeds, feeds, depth of cut, material to be used, estimated time for setting up the job and for machining, as well as the total time for doing the work, are given. In addition, columns are provided for recording the number of parts finished, number of parts lost in operation, and number of parts found defective. A column giving the operator's number identifies the work with the man doing it. This operation sheet has been found convenient and meets the requirements very well. In the column headed "Time Per Each Operation" is recorded the time on a certain quantity of pieces for each setting. In the next column is recorded the time on one piece for each setting.

SHEET NO._____ ROCKFORD MILLING MACHINE CO. DATE STARTED_____

Machining Operation

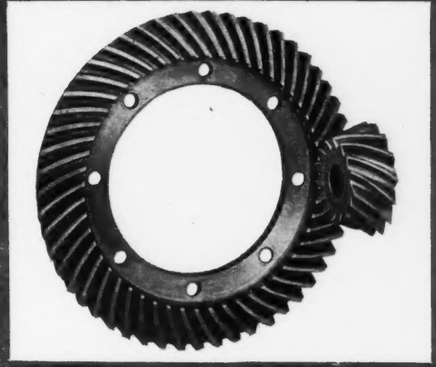
LOT NO._____ DATE FINISHED_____

PART NO._____ NAME OF PART_____ PARTS STARTED_____

Dept. No.	Settings	Operation Number	Operator's Number	OPERATION	TYPE AND SIZE OF MACHINE	TOOLS, FIXTURES, AND GAGES	Setting Job	Speed	Feed	Depth of Cut	Material	Time per Each Oper'n	Time, One Piece, Each Operation	No. of Parts Finished	No. of Parts Lost in Oper'n	No. of Parts Defective	Total Time		Checked By
							Hours					Hours	Min.				Hours		

Machinery

Convenient Shop Operation Sheet used by Rockford Milling Machine Co.



Strength of Spiral-Type Bevel Gears

Formulas for Determining Strength of Spiral-type Bevel Gears and Principles upon which they Depend—By Reginald Trautschold[1]

AUTOMOBILE manufacturers who have adopted the spiral type of bevel gears in their transmissions have discovered that such gears, when accurately formed by generating machines, are appreciably stronger than similar bevel gears with straight teeth. With the present-day tendency to lighten car construction as much as possible, so as to reduce the dead weight propelled by the engine, the gearing unquestionably offers a field in which a certain saving in weight can be profitably made. Any reduction in the weight of gearing can only be considered, however, if there is no sacrifice in safety; that is, the gearing must be proportioned for strength according to the accepted Lewis formula for the strength of gear teeth. Departure from the proved practice of years would be detrimental to the interests of any manufacturer reckless enough to disregard past experience. The spiral type of bevel gear is quite unlike the plain spur gear, so that neither the Lewis formula nor the modified form suggested by Carl G. Barth, in which the speed factor ratio is introduced, can be used without considerable modification.

Before considering these modifications, a peculiar feature of the spiral type of bevel gear construction should be investigated, as it materially affects the strength of such gears. The cutter angle of the rotary generating tool employed to form the convex side of the teeth is slightly greater than the cutter angle used for forming the concave side. The variation is slight, but it is sufficient to give to each side of the tooth a slightly different, although similarly curved, profile. The effect of this construction on forward rotation is similar to that produced if the driving member in a gear combination has a greater pressure angle than the driven gear; the contact will commence on the pitch line of the teeth, not at the top of the teeth, as when the pressure angles of both gears are similar.

In Fig. 1 is shown the outline of a 14.5-degree driven tooth superimposed on a tooth having a 20-degree pressure angle, but which is otherwise of the same pitch proportions. The illustration shows only the outline of the teeth, but, as the tooth spaces must be conjugates of the teeth, it is evident that contact between addendum tooth profiles cannot take place between advancing tooth profiles in such an arrangement. As the addendum section of the driving tooth rolls into contact with the dedendum section of the driven tooth, a slight acceleration will be given to the driven gear. This, however, will not load the receding tooth profiles if the variation in their respective pressure angles is reversed, as it is in the spiral type bevel gear construction, for then the more obtuse pressure angle of the advancing driven-gear profile makes that profile slightly flatter than the receding profile of the driving-gear tooth. An exactly similar action takes place when spiral-type bevel gears are run together in forward rotation: The advancing profile of the driving gear has a slightly more obtuse pressure angle than the contact profile of the driven gear, while the pressure angles of the opposite profiles are reversed. The variation in the pressure angle of the convex and the concave tooth profiles is so slight in spiral-type bevel gears, however, that there is no appreciable acceleration as the gears roll into mesh, but there can be no stress on the teeth until they are in full mesh. This peculiarity, as well as the fact that more than one set of teeth is always partly in full mesh, has much to do with the silent properties of spiral-type bevel gears, and explains why they may be considerably stronger than similarly proportioned straight-tooth bevels.

Fig. 2 illustrates, diagrammatically, the stress to which gear teeth of the same pitch and size of gear, but differing in proportions, are subject at the instant of the first contact. At *A* is shown an ordinary involute tooth of standard proportions; at *B*, an involute tooth with an addendum equal to three-tenths the working depth of the tooth, but of the same total depth; and at *C*, the stress to which a spiral-type bevel gear tooth proportioned similarly to the tooth shown at *B* will be subject.

Investigation of a number of ordinary involute teeth of standard proportions that have been broken through excessive stress shows that fracture invariably occurs just within the dedendum circle, at a point approximately 7 per cent of the circular pitch from the dedendum circle. The line of fracture for teeth with an addendum equal to three-tenths the working depth probably occurs somewhat nearer the pitch circle, so that the line of fracture for the average tooth may safely be taken as on the dedendum circle, even in the case of a tooth that is appreciably under-cut. The breaking-moment arm *M* is, then, the length of a normal from the center of the fracture line to the pressure plane through the point of first contact. The force exerted on the tooth at the instant of first contact is, obviously, the same in amount for the three tooth constructions illustrated, so that the strength of the respective teeth is governed simply by the length of the breaking-moment arm *M* and the square of the chordal root thickness of the tooth at its weakest section, or just above the fillets.

Proportioning the teeth with a short addendum and a long dedendum, as shown at *B*, Fig. 2, increases the breaking-moment arm *M* slightly, and at the same time decreases the chordal thickness at the root of the tooth, so that the resulting tooth is considerably weaker than one of the same pitch, etc., and of standard proportions. Conversely, a tooth with a long addendum and a short dedendum is stronger than a tooth of standard proportions. If the proportions of the tooth shown at *B* are retained, but the loading of the tooth delayed until the pressure is first applied at the pitch line, as in the case of the driven gear in a set of spiral type (which is usually the weaker member of the combination on account of its short addendum and long dedendum) or as illustrated at *C*, Fig. 2, the breaking-moment arm *M* is considerably reduced, although the chordal thickness of the tooth remains the same. The result is a stronger tooth than the tooth of standard proportions.

Breaking-moment Arm Factor

In the case of the teeth shown at *A* and *B*, Fig. 2, the length of the breaking-moment arm, assuming the probable line of

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fracture to be tangent to the dedendum circle, is dependent, for all practical purposes, upon the whole depth W of the tooth and the pressure angle at the instant of contact. Actually, the governing length of the tooth is equal to the distance between a plane tangent to the dedendum circle at the neutral axis of the tooth and the point of first contact; this dimension is but slightly less than the whole depth of the tooth. The decrease is equal to the height of the arc forming the top of the tooth, or, in the case of the tooth shown at C, to the height of the semicircular pitch arc. As the whole depth of the tooth will be used only for comparative ratios, any error arising in the calculation of the breaking-moment arm M may be safely overlooked. The ratio of the breaking-moment arm to the whole

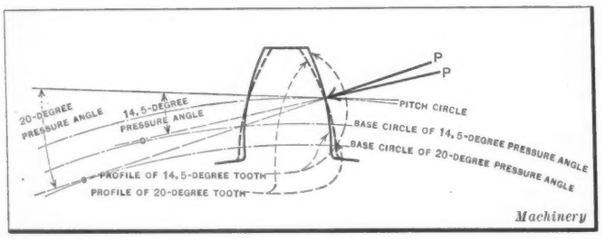


Fig. 1. Tooth Profiles with Different Pressure Angles

depth W of the tooth will then equal the ratio of the diameter of the base circle of the gear to the diameter of the circle on which tooth contact first occurs, so that the breaking-moment arm is equal to the whole depth of the tooth multiplied by the quotient of the base circle diameter divided by the diameter of the circle of first tooth contact.

In the case of gears on which tooth contact commences at the top of the teeth (all gears with similar pressure angle for either tooth profile), the breaking-moment arm is equal to the product of the whole depth of tooth multiplied by the diameter of the base circle divided by the outer diameter of the gear. In the case of gears on which tooth contact does not occur until they are in full mesh (gears on which the first tooth contact occurs on the pitch line), as with spiral-type bevel gears, the breaking-moment arm is equal to the product of the dedendum multiplied by the diameter of the base circle divided by the pitch diameter. The dedendum dimension is used in this case instead of the whole depth of the tooth, as contact between meshing teeth does not occur over the addendum section of the short-addendum gear. (See Fig. 2 and derivation of breaking-moment arm formulas.)

The influence of the altered breaking-moment arms on the strength of the teeth is found by dividing the breaking-moment arm for teeth with standard addendum (1) by the breaking-moment arm for teeth with short addendum, and (2) by the breaking-moment arm for teeth of the spiral-type bevel gear variety with short addendum. For standard gears with the addendum equal to three-tenths the working depth of the tooth, the modified breaking-moment arm factors are equal to the strength factor of gear teeth with standard addendum multiplied by the ratio of the number of teeth plus 1.2 to the number of teeth plus 2. For spiral-type bevel gears with short addendum, the modified breaking-moment arm factors are equal to the strength factor of gear teeth with standard addendum multiplied by the quotient of 1.385 times the number of teeth divided by the number of teeth plus 2. In the first instance, the breaking-moment arm factor is somewhat increased, and in the second, it is appreciably reduced.

For gears in which the addendum is made seven-tenths the working depth of the tooth (mating pinions for gears with short-addendum teeth), the breaking-moment arm factor is considerably reduced, whether the load is first applied at the top of the teeth or on the pitch line, as in the case of spiral-type bevel gears. For such long-addendum, short-dedendum pinions, the factors controlling the strength of the teeth due to the decreased dedendum dimensions are derived in a manner similar to that employed for ascertaining the corresponding factors for short-addendum teeth. For standard pinions with long-addendum teeth, the modified breaking-moment arm factors are equal to the strength factor of gear teeth with standard addendum multiplied by the ratio of the number of teeth plus 2.8 to the number of teeth plus 2. For spiral-type bevel gears with long addendum, these factors are equal to the strength factor of gear teeth with standard addendum multiplied by the quotient of 2.85 times the number of teeth divided by the number of teeth plus 2.

Root Thickness Factor

Reducing the addendum and correspondingly increasing the dedendum dimensions of gear teeth results, if the gear has twelve or more teeth, in reducing the root thickness of the teeth—under-cutting the teeth—so that such practice is limited to gears with a considerable number of teeth. In gears with less than twelve teeth, the comparatively large angle included, subtended on the dedendum circle, is greater than the pressure angle, so that there is a slight increase in the root thickness of the teeth. In any case, the circular thickness C of gear teeth on an arc just clearing the fillets is proportional to the distance between the tops of similar adjacent involute rack teeth. The chordal thickness T of the teeth just above the fillets, the thickness of the teeth on the probable line of fracture, is equal to the dedendum diameter of the gear plus twice the clearance multiplied by the sine of the angle measured on the pitch circle by one-half the circular thickness of the teeth just above the fillets.

Dividing the chordal thickness of teeth with standard addendum by that of teeth with short or long addendum, measures the proportional root thickness resulting from increasing or decreasing the dedendum. In the instance of making the addendum three-tenths the working depth of the tooth, the reduction in root thickness increases with the number of teeth above twelve, but for gears with less than twelve teeth, the root thickness is slightly increased. On the other hand, when the addendum is made equal to seven-tenths the working depth of the tooth, the root thickness is increased for gears with

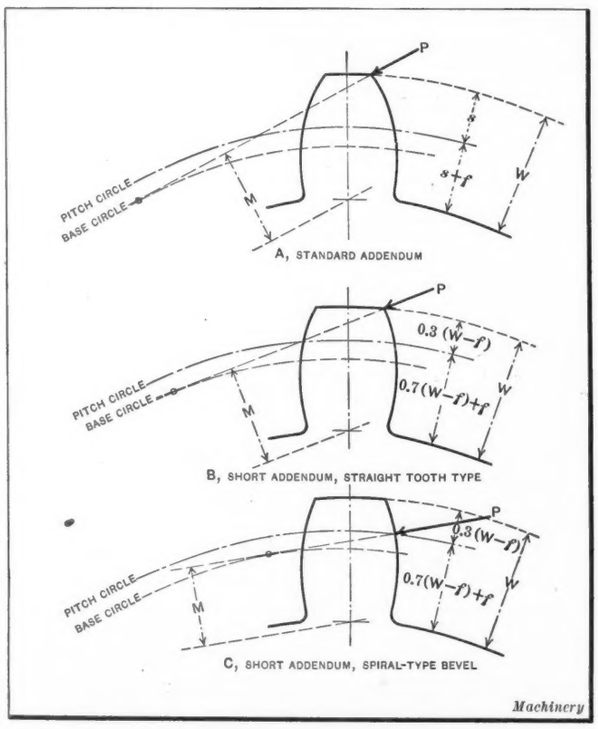


Fig. 2. Strength of Gear Teeth of Different Proportions

ten or more teeth, the increase becoming larger and larger as the gear approaches the rack form. The root thickness of pinions with long-addendum teeth numbering less than ten is slightly reduced when the addendum is made seven-tenths the working depth of the teeth, but, owing to the reduced breaking-arm moment, the teeth are likely to be slightly stronger than the teeth of similar gears with standard addendum.

Comparative Strength of Teeth with Short and Long Addenda

The y factor in the Lewis formula for the strength of gear teeth is proportional to the strength of the teeth, and, if this is multiplied by $\frac{N+1.2}{N+2}$ and the product is again multiplied by the square of the comparative root thickness just above the fillets, a similar factor Y_1 will be obtained for gears with an addendum equal to three-tenths the working depth of the tooth. Similarly, the Lewis y factor multiplied by $\frac{1.385 \times N}{N+2}$ and then by the square of the comparative root thickness just above the fillets will give a similar factor Y_2 applicable for calculations for the strength of spiral-type bevel gears with short addendum. For pinions with long addendum, the Lewis y factor multiplied by $\frac{N+2.8}{N+2}$ and then by the square of the comparative root thickness just above the fillets gives a similar factor y_1, for pinions with an addendum equal to seven-tenths the working depth of the teeth; and the Lewis y factor multiplied by $\frac{2.85 \times N}{N+2}$ and the product by the square of the comparative root thickness gives a factor y_2, which is applicable for the calculation of the strength of spiral-type bevel pinions with long addendum.

Notation of Breaking-moment Arm Formulas

D = pitch diameter;
B = base circle diameter;
f = clearance;
N = number of teeth;
O = outside diameter;
W = whole depth of tooth;
a = pressure angle;
M = breaking-moment arm;
Arrangement A = straight-tooth gears with standard addendum;
Arrangement B = straight-tooth gears with short addendum;
Arrangement C = spiral-type bevel gears with short addendum.

Breaking-moment Arm Formulas

$$B = D \cos a \qquad W - f = \frac{2D}{N}$$

$$W = \frac{2.157D}{N} \qquad f = \frac{0.157D}{N}$$

Arrangement A:

$$M = \frac{WB}{O} = \frac{WD \cos a}{D + (W - f)} = \frac{\frac{2.157D \times D \cos a}{N}}{\frac{DN + 2D}{N}} = \frac{2.157D \cos a}{N+2}$$

Arrangement B:

$$M = \frac{WB}{O} = \frac{WD \cos a}{D + 0.6\,(W - f)} = \frac{\frac{2.157D \times D \cos a}{N}}{\frac{DN + 1.2D}{N}} = \frac{2.157D \cos a}{N+1.2}$$

Arrangement C:

$$M = \frac{[0.7(W - f) + f]\,B}{D} = \frac{\frac{(1.4D + 0.157D)\,D \cos a}{N}}{D} = \frac{1.557D \cos a}{N}$$

$$\frac{M \text{ for Arrangement } A}{M \text{ for Arrangement } B} = \frac{2.157D \cos a}{N+2} \times \frac{N+1.2}{2.157D \cos a} = \frac{N+1.2}{N+2}$$

$$\frac{M \text{ for Arrangement } A}{M \text{ for Arrangement } C} = \frac{2.157D \cos a}{N+2} \times \frac{N}{1.557D \cos a} = \frac{1.385N}{N+2}$$

Notation of Root Thickness Formulas

D = pitch diameter;
P = diametral pitch;
N = number of teeth;
T = chordal thickness of tooth above fillets;
C = circular thickness of tooth above fillets;
D_1 = dedendum diameter plus twice the clearance;
a = pressure angle;
β = angle measured by half of circular root thickness above fillets;
Arrangement A = straight-tooth gears with standard addendum;
Arrangement B = straight-tooth gears with short addendum;
Arrangement C = spiral-type bevel gears with short addendum;
Arrangement D = straight-tooth gears with long addendum;
Arrangement E = spiral-type bevel gears with long addendum.

Root Thickness Formulas

Arrangement A:

$$D_1 = D - \frac{2D}{N} = \frac{N}{P} - \frac{2}{P} = \frac{N-2}{P}$$

STRENGTH FACTORS FOR MODIFIED LEWIS FORMULAS FOR GEARS WITH LONG- AND SHORT-ADDENDUM TEETH

Number of Teeth	Standard Factor y	Factor for Gears with Short Addendum Y_1	Factor for Spiral-type Gears with Short Addendum Y_2	Factor for Pinions with Long Addendum y_1	Factor for Spiral-type Bevel Pinions with Long Addendum y_2
8	0.051	0.052	0.062	0.053	0.111
9	0.055	0.054	0.066	0.058	0.127
10	0.059	0.056	0.070	0.064	0.142
11	0.063	0.059	0.074	0.069	0.157
12	0.067	0.062	0.078	0.076	0.172
13	0.070	0.063	0.081	0.079	0.185
14	0.072	0.065	0.083	0.082	0.195
15	0.075	0.067	0.086	0.086	0.208
16	0.077	0.069	0.089	0.089	0.216
17	0.080	0.071	0.092	0.093	0.227
18	0.083	0.073	0.095	0.097	0.238
19	0.087	0.076	0.099	0.101	0.251
20	0.090	0.079	0.103	0.105	0.263
21	0.092	0.080	0.105	0.108	0.272
23	0.094	0.082	0.108	0.111	0.282
25	0.097	0.084	0.111	0.115	0.294
27	0.100	0.086	0.114	....	....
30	0.102	0.088	0.117	....	....
34	0.104	0.089	0.120	....	....
38	0.107	0.091	0.122	....	....
43	0.110	0.093	0.126	....	....
50	0.112	0.095	0.128	....	....
60	0.114	0.096	0.130	....	....
75	0.116	0.097	0.132	....	....
100	0.118	0.099	0.134	....	....

Machinery

$$\frac{C}{2} = \frac{0.7854 + \tan a}{P}$$

$$\beta = \frac{\frac{360\,(0.7854 + \tan a)}{P}}{\frac{3.1416N}{P}}$$

$\beta = \frac{119.63}{N}$, for 14.5-degree involute teeth

$$T = D_1 \sin \beta = \frac{(N-2) \sin \beta}{P}$$

Arrangements B and C:

$$D_1 = \frac{N}{P} - \frac{2.8}{P} = \frac{N-2.8}{P}$$

$$\frac{C}{2} = \frac{0.7854 + 1.4 \tan a}{P}$$

$$\beta_1 = \frac{\dfrac{360\ (0.7854 + 1.4 \tan \alpha)}{P}}{\dfrac{3.1416N}{P}}$$

$$\beta_1 = \frac{131.49}{N}, \text{ for 14.5-degree involute teeth}$$

$$T = D_1 \sin \beta = \frac{(N - 2.8) \sin \beta_1}{P}$$

Arrangements D and E:

$$D_1 = \frac{N - 1.2}{P} \qquad \frac{C}{2} = \frac{0.7854 + 0.6 \tan \alpha}{P}$$

$$\beta_2 = \frac{107.78}{N}, \text{ for 14.5-degree involute teeth}$$

$$T = D_1 \sin \beta_2 = \frac{(N - 1.2) \sin \beta_2}{P}$$

$$\frac{T \text{ for Arrangement } A}{T \text{ for Arrangements } B \text{ and } C} = \frac{(N - 2) \sin \beta}{(N - 2.8) \sin \beta_1} = T_1$$

$$\frac{T \text{ for Arrangement } A}{T \text{ for Arrangements } D \text{ and } E} = \frac{(N - 2) \sin \beta}{(N - 1.2) \sin \beta_2} = T_2$$

Notation of Formulas for Finding Strength Factors for Modified Lewis Formula

y = standard factor;
Y_1 = factor for gears with short addendum, 0.3 times working depth of tooth;
Y_2 = factor for spiral-type bevel gears with short addendum;
y_1 = factor for pinions with long addendum, 0.7 times working depth of tooth;
y_2 = factor for spiral-type bevel pinions with long addendum;
N = number of teeth in gear;
T_1 and T_2 = chordal thickness of teeth above fillets.

Formulas for Finding Strength Factors for Modified Lewis Formulas for Gears with Long and Short Addendum Teeth

$$Y_1 = \frac{T_1^2 y\ (N + 1.2)}{N + 2} \qquad y_1 = \frac{T_2^2 y\ (N + 2.8)}{N + 2}$$

$$Y_2 = \frac{1.385 N y T_1^2}{N + 2} \qquad y_2 = \frac{2.85 N y T_2^2}{N + 2}$$

Notation of Formulas for Strength and Power Capacity of Spiral-type Bevel Gears

S = safe working stress, in pounds per square inch;
P = diametral pitch;
P_1 = circular pitch, outer end of teeth;
P_2 = average circular pitch;
O = pitch diameter, outer;
D = average pitch diameter;
N = number of teeth;
F = face width;
E = distance from apex to outer end of tooth;
δ = center angle;
θ = spiral angle;
R = revolutions per minute;
V = average velocity in feet per minute.

Formulas for Strength and Power Capacity of Spiral-type Bevel Gears

$$E = \frac{O}{2 \sin \delta} \quad (1) \qquad P_2 = \frac{P_1 (E - 0.5F)}{E} \quad (3)$$

$$P_1 = \frac{3.1416}{P} \quad (2) \qquad D = 0.3183 P_2 N \quad (4)$$

$$V = 0.2618 DR \quad (5)$$

Total load on spiral-type bevel gear teeth = transmitted load × sec θ (6)

Transmitted load = total load × cos θ (7)

Straight-tooth bevel gears with standard addendum:

$$\text{Safe load} = S P_2 F y \left(\frac{600}{600 + V} \right) \quad (8)$$

Straight-tooth bevel gears with short addendum, 0.3 times working depth of tooth:

$$\text{Safe load} = S P_2 F Y_1 \left(\frac{600}{600 + V} \right) \quad (9)$$

Spiral-type bevel gears with short addendum:

$$\text{Safe load} = S P_2 F Y_2 \cos \theta \left(\frac{1200}{1200 + V} \right) \quad (10)$$

Straight-tooth bevel pinions with long addendum, 0.7 times working depth of tooth:

$$\text{Safe load} = S P_2 F y_1 \left(\frac{600}{600 + V} \right) \quad (11)$$

Spiral-type bevel pinions with long addendum:

$$\text{Safe load} = S P_2 F y_2 \cos \theta \left(\frac{1200}{1200 + V} \right) \quad (12)$$

Power capacity of bevel gears:

$$\text{Horsepower} = \frac{\text{safe load} \times V}{33{,}000} \quad (13)$$

Notes on Formulas for Strength of Bevel Gears

The Lewis formula, as modified for straight-tooth bevel gears, is not directly applicable to spiral-type bevel gears by the simple substitution of new y values, as two other peculiarities of that type of gear materially affect its strength and power-transmitting capacity. In the first place, there is an entire absence of shock, as spiral-type bevel gears roll into mesh. In this respect, they are similar to gears of the herringbone type and the same modification of the strength formula should be made as has been found necessary for herringbone gears. W. C. Bates found that the transference of load from tooth to tooth without shock in herringbone gearing modified the speed-factor ratio added to the Lewis formula by Carl G. Barth by changing the constant 600 to 1200. This modification, which has been necessary in the case of herringbone gears, should also be made in the case of spiral-type bevel gears, as the two types are similar as far as elimination of shock is concerned. The second modification is caused by the thrust produced by the obliquity of the spiral teeth and is dependent upon the spiral angle of the gear. The total load on a spiral-type bevel gear tooth—the resultant of the transmitted load and the thrust—is equal to the transmitted load multiplied by the secant of the spiral angle. Then the safe load that can be put on the spiral-type bevel gear is the load that it could carry were it not for the thrust multiplied by the cosine of the spiral angle. The safe load for spiral-type bevel gear teeth, therefore, takes the form given in Formula (10).

Example—Required the horsepower and safe load, when run at 600 revolutions per minute and having a safe working stress S of 15,000 pounds per square inch, 25 teeth, 5 diametral pitch, and a 1.75-inch face: (a) of a 90-degree spiral-type bevel gear having a 30-degree spiral angle and a short addendum; (b) of a 90-degree straight-tooth bevel gear with a standard addendum; and (c) of a straight-tooth bevel gear with a short addendum; that is, 0.3 addendum and 0.7 dedendum.

Applying Formula (2), the circular pitch P_1 measured at the outer end of the teeth is $3.1416 \div 5 = 0.6283$ inch. As the outer pitch diameter O is $25 \div 5 = 5$ inches and the center angle δ is 45 degrees, by Formula (1), the apex distance E is $\dfrac{5}{2 \times 0.70711} = 3.535$ inches. The average circular pitch P_2, therefore, by Formula (3), is

$$\frac{0.6283\ (3.535 - 0.875)}{3.535} = 0.4728 \text{ inch}$$

Then, by applying Formula (4), the average pitch diameter D is $0.3183 \times 0.4728 \times 25 = 3.7623$ inches, and, by Formula (5), the average velocity V is $0.2618 \times 3.7623 \times 600 = 590.982$, say 590 feet per minute.

For (a), then, applying Formula (10), the safe load is

$$\frac{15{,}000 \times 0.4728 \times 1.75 \times 0.111 \times 0.866 \times 1200}{1200 + 590} = 800 \text{ pounds,}$$

very nearly, and the power capacity, by Formula (13), is

$$\frac{800 \times 590}{33{,}000} = 14.3 \text{ horsepower.}$$

For (b), by Formula (8), the safe load is

$$\frac{15{,}000 \times 0.4728 \times 1.75 \times 0.097 \times 600}{600 + 590} = 606.99 \text{ pounds,}$$

and the power capacity, by Formula (13), is

$$\frac{606.99 \times 590}{33{,}000} = 10.85, \text{ say } 10.9, \text{ horsepower.}$$

For (c), by Formula (9), the safe load is

$$\frac{15{,}000 \times 0.4728 \times 1.75 \times 0.084 \times 600}{600 + 590} = 525.64 \text{ pounds,}$$

and the power capacity, by Formula (13), is

$$\frac{525.64 \times 590}{33{,}000} = 9.397, \text{ say } 9.4, \text{ horsepower.}$$

If the power capacity of gear (c), which is 9.4 horsepower, is taken as 1, the comparative strength of gear (b) is $\frac{10.9}{9.4} = 1.16 \times$ gear (c); the comparative strength of gear (a) is $\frac{14.3}{9.4} = 1.52 \times$ gear (c); and $\frac{14.3}{10.9} = 1.31 \times$ gear (b).

This example shows that a 25-tooth, 5 diametral pitch, 1.75-inch face, 90-degree spiral-type bevel gear with a 30-degree spiral angle, the customary obliquity, and constructed of steel having a safe working stress of 5000 pounds per square inch can transmit 14.3 horsepower at 600 revolutions per minute. A similar straight-tooth bevel gear with standard addendum will be safe to transmit less than 11 horsepower at the same speed; while a straight-tooth bevel gear with an addendum equal to three-tenths of the working depth of the tooth, in order not to under-cut the mating pinion, will only be good for 9 1/3 horsepower. The possible saving in the weight of bevel gearing through the use of spiral-type bevel gears is apparent, as the spiral-type bevel gear is 35 per cent stronger than the similar straight-tooth bevel gear with standard addendum, and 56 per cent stronger than the similar straight-tooth bevel gear with short addendum.

* * *

DELAYS CAUSED BY EXACTING GOVERNMENT SPECIFICATIONS

BY A. M. M.

The government specifications that accompanied all contracts for machinery or raw materials previous to the war were so exacting that manufacturers were obliged to make higher bids and specify more time on government contracts than on ordinary commercial work. In many cases manufacturers found that only by producing machinery or materials that were greatly superior to the generally accepted first-class commercial product could they meet the government requirements. Now that the war has brought a demand for maximum production to all our manufacturing concerns, it has been found that these over-exacting specifications have, in many cases, seriously affected production. It has also been found that in many cases these specifications can be made less exacting without affecting the material value of the product. If the war serves to eliminate these exacting specifications that experience and careful testing prove to be unnecessary, a great economic work will have been accomplished. If specifications are substituted that more nearly conform to those that have been found suitable by the leading manufacturers of high-class machinery, the manufacturing concerns will not be obliged to bid higher and specify more time on government contracts in order to protect themselves from the delays and expense they have often experienced in attempting to meet the government requirements.

An instance of how the extremely exacting government specifications affect production may be cited in the manufacture of condenser tubes. One of the leading manufacturers of brass tubes for condensers was given a government contract for large quantities of condenser tubes with instructions to rush deliveries. The specifications included a compression test of the material which caused the ordinary brass that had previously been found satisfactory for condensers to be rejected. The test was apparently based on the hardest piece which could be found among all the commercial stock. In order that the tubes might pass inspection, it was necessary to make the average much harder than the ordinary stock; for in manufacturing such tubes there is quite a wide variation in the hardness, and in order that a large percentage should not fall below the requirements, it was necessary to make them all unusually hard. After delays incident to such manufacture, the tubes were delivered. They were purposely specified "Extra hard," and yet they were assembled without annealing the ends before expanding. As a result, 5 or 10 per cent of them cracked during the expanding process. All were then removed and the entire lot rejected. After a serious delay, the government specifications for hardness were made less exacting and the tubes were made over.

This whole difficulty was the result of the government policy of having something made a little better than the regular commercial product. An extra load was thus thrown on the brass company, which was already working 100 per cent on government orders. After a few experiences of this kind, almost any company will bid higher and specify more time on government contracts in order to protect themselves against such conditions.

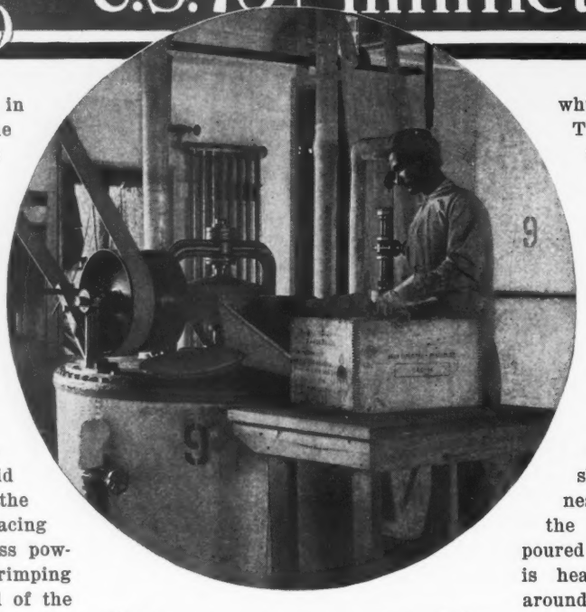
Millions of extra costs and months of delay may result from over-exacting specifications. In the past, these unduly severe specifications have been considered as a matter of course, and no one has been censured for making them; but if a government official should write a specification which seemed good enough, according to general practice, but which later for any reason permitted some inferior material to be accepted, the mistake would be held to outweigh all the gains he may have previously realized from his common-sense practice. For this reason there is a tendency to make specifications unduly exacting, thus throwing the burden on the manufacturers. Before this state of things can be changed, some way will have to be found to relieve government officials from adverse criticisms when they make specifications according to their best judgment, which later allow some unsuitable material to pass inspection.

Another cause of delay in filling government orders is the custom of refusing to pass an invoice for payment if some trifling item is omitted in the shipment. About half a year ago one of the well-known dealers of mechanical equipment delivered goods on a government order amounting to about $15,000. Several small collets were missing. These articles were not an integral part of the machines, but were specified as equipment. For some reason the dealer has not yet been able to obtain these items, and without them he has been unable to obtain any part of the $15,000. This dealer now has on his books government orders for much needed equipment, each order calling for certain machines, and a large list of special equipment. The machines with regular commercial equipment might be shipped almost immediately, but the dealer feels that he cannot make any shipments until the last item mentioned in the order is ready, as he would be tying up large amounts of money for an indefinite period. Consequently, a few spare parts which may never be needed cause delays of two or three months in shipping these machines.

* * *

A complete report on the Australian customs tariff as it stands today has been made public in a bulletin issued by the Bureau of Foreign and Domestic Commerce, Department of Commerce. The purpose of the report is to post American manufacturers and exporters on points in the new tariff that are not generally understood in this country. The preferential provisions, by which goods made in England and South Africa enjoy advantages over all others, are treated in great detail. The bulletin is entitled "Customs Tariff of Australia," Tariff Series No. 37. Copies can be obtained at ten cents each from the Superintendent of Documents, Government Printing Office, Washington, D. C., or from any of the district or cooperative offices of the Bureau of Foreign and Domestic Commerce.

Loading the U.S. 75-Millimeter Shell



Fifth of a Series of Articles Describing the Methods Employed by the T. A. Gillespie Co. in Making the U. S. 75-millimeter Shell—By Erik Oberg[1]

IN the four preceding articles in this series, published in the March, April, May, and June numbers of MACHINERY, the forging, machining, and inspection of the U. S. 75-millimeter shell were described in detail. In the present article, which is the last one in this series, the loading of the shell will be dealt with. Briefly described, the loading consists in filling the shells with a high explosive, which is poured into the shells in a molten condition and sets into a solid form within the shell, inserting the primer in the cartridge case, placing the required charge of smokeless powder in the cartridge case, and crimping the cartridge case onto the end of the shell. After painting and marking, the shells are ready to be shipped to France, the fuses being inserted on the field when the shells are ready to be used.

Preliminary Operations

In the preceding articles in this series, the shell was followed through the machining operations and inspection to the point where it was placed in cartons ready for shipment. The shells are received at the loading plant in this condition, and the first operation is to remove them from the cartons. They are then placed upon a belt conveyor which takes them to a shellacking machine in which the shell is rotated while a shellacking "gun" is inserted by the operator into the shell cavity for coating the inside with a rosin shellac. The shell is then put back on the conveyor and passes to a drying table on which it is left a few hours to dry. A piece of paper is then wrapped around the shell, the two ends of the paper being pasted together. The object of this wrapper is to prevent the molten high explosive, that may be spilled, from adhering to the outside of the shell when poured into it; it will adhere to the paper instead, which can be torn off.

Fig. 1 shows a number of these shells provided with a paper wrapping and stored on the tables in the storage rooms ready to be passed to the room where the shells are loaded. A conveyor takes the shells from this room to the loading room. This conveyor is a double-track roller conveyor on which wooden boxes are placed having holes or compartments in them in which the shells are placed on end. These boxes are generally made to hold eight shells each. Between the shellacking and storage room and the room where the high-explosive charge is poured into the shells is a preheating oven about 175 feet long, through which the conveyor tracks pass. In this oven, the shells are preheated to a temperature of about 40 degrees C. (104 degrees F.), the object of this preheating being to take the chill off the shells so that they will be more nearly of the same temperature as the molten high explosive that is poured into them. The preheating oven is heated by air previously passed around steam coils and forced through the oven duct by a fan. The duct has a capacity for 2500 shells at a time.

Pouring High Explosive

From the preheating oven, the boxes containing the shells pass into the pouring room, still moving along the conveyor as indicated in Fig. 2. A shee-iron funnel is placed in the opening of each shell, as indicated in the illustration, which shows a number of shells ready for pouring.

The high explosive used for the 75-millimeter shells is trinitrotoluol, generally known as T.N.T. This explosive is obtained by the loading factory from the high explosives manufacturers in the form of a yellow powder, somewhat similar to powdered brown sugar. The melting kettles for melting this powder, so that it can be poured into the shells in a liquid form, are placed on the second floor of the building, and piping extends from the kettles down to the first floor, so that the liquid can be drawn into "tubs" on the lower or pouring floor. The melting kettles are steam-jacketed, and as the melting point of T.N.T. is about 80 degrees C. (176 degrees F.), it is easily melted by steam at a comparatively low pressure. The general appearance of one of these melting kettles is shown in Fig. 3. The belt and pulley shown drive, by means of bevel gearing, a shaft which passes down through the kettle, onto which are attached paddles for stirring the mixture while melting.

The molten mixture is now drawn from the bottom of the kettles on the lower floor into tubs or containers such as shown

[1] Editor of MACHINERY.

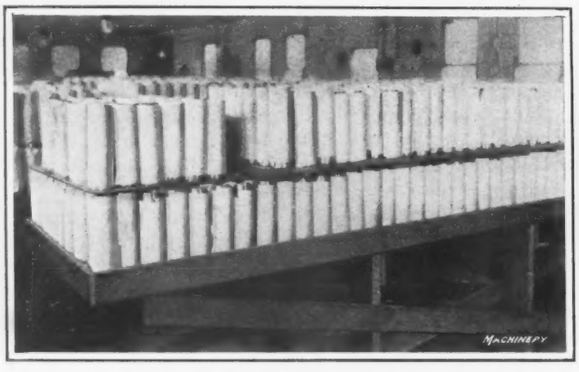


Fig. 1. High-explosive Shells with Paper Wrapping Ready to be passed on to Loading Room



Fig. 2. Shells placed in Boxes on Roller Conveyor with Funnels Ready for pouring T.N.T.

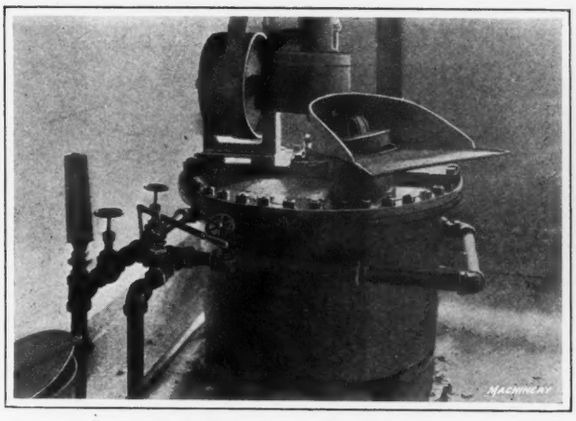


Fig. 3. Steam-jacketed Kettle for melting T.N.T. so that it can be poured into Shells in a Liquid Form



Fig. 4. Shells after High Explosive has been poured into them, and before Funnels have been knocked off

at *A*, Fig. 5. These tubs are placed on trucks so that, after having been filled by the molten high explosive, they may be easily removed to the cooling machines, one of which is shown in Fig. 5. In these machines, the liquid is mechanically stirred by a paddle until of just the right temperature for pouring into the shells. One of the two ducts shown at the top of the machine forces the cool air into the hood above the tub, while the other duct carries off the hot air and fumes from the liquid. The pourer determines when the liquid has reached the right temperature by dipping the end of a knife into the tub and judging by the appearance of the crystals when the liquid cools on the end of the blade.

The cooling tubs are provided with connections for steam pipes, as indicated at *B*, so that any explosive charge that solidifies in the bottom of the tub can be melted by merely passing steam through the jacket which surrounds the inner tub. In this way, the tubs can always be kept clean.

After the molten liquid has reached the right temperature, which varies somewhat according to the atmospheric conditions, but is generally between 77 and 80 degrees F., it is withdrawn from the cooling machine, pulled up close to the conveyor upon which the shells are placed ready for pouring, and the liquid is poured from the tubs into pails from which the workmen pour it into the funnels placed in the shells. The liquid is poured into the shell until it has not only filled the shell completely, but also stands about half way up in the funnel. The object of this is to provide enough liquid so that when it contracts in the shell, upon cooling, there will be enough material to be drawn upon from the funnel to insure that the shell is completely filled. The funnel is permitted to remain in the shell opening for about an hour, until the liquid has solidified, at which time it is removed by simply pulling it off by hand, after which the part of the charge remaining in the funnel is knocked out of it with a copper hammer, and remelted. The object of using a copper hammer is to prevent any spark that might form in case a steel hammer was used against the sheet iron, which might explode the T.N.T. The paper wrapping around the shell is then removed, and the charge in the shells permitted to set for two hours more, after which the shells are cleaned off on the outside from any T.N.T. that might have been spilled upon them. Fig. 4 shows a view in the room where the funnels are removed from the filled shells and the shells cleaned.

Boring for Booster and Cleaning Threads

The shells now pass to the boring room in which the cavity in the high explosive for the booster is bored out. Part of the machine in which the boring is performed is shown in Fig. 6. The machine works automatically after the shell has been placed in it, and bores a hole in the T.N.T. charge by means of a steel drill. To provide against any possible explosion, these machines are each set in a circular enclosure consisting of 5/8-inch armor-plate surrounded by an 8-inch thick wall of concrete, this enclosure being partly open on one side only for the insertion of the shells to be bored, the opening facing a wall. Hence, the operators do not need to stand in front of these machines while they are operating. The dust from the boring is carried away by a duct so as to prevent the air around the machines from being charged with this dust. After the boring, the cavity for the booster is inspected.

The shells next pass to the thread-cleaning room where the

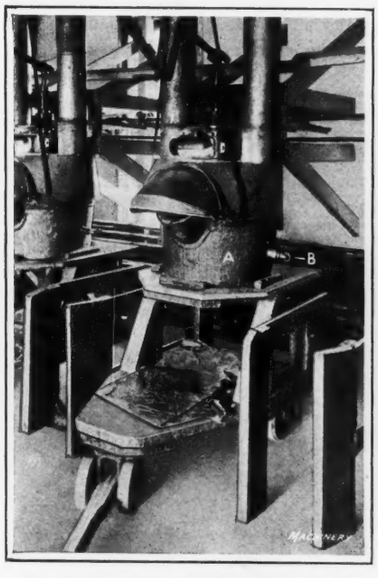


Fig. 5. Device for cooling Molten High-explosive Charge to Right Temperature for Pouring



Fig. 6. Machine used for boring out Cavity in High-explosive Charge in Shell for Booster



Fig. 7. Cleaning out Threads in Shell. Compressed Air is blown into Cavity to remove Dust

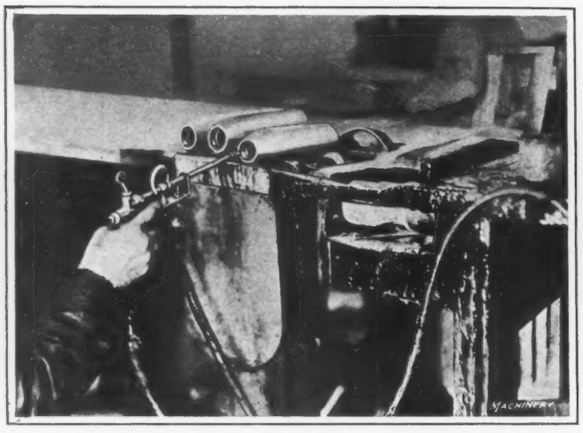


Fig. 8. Varnishing Inside of Cavity for Booster

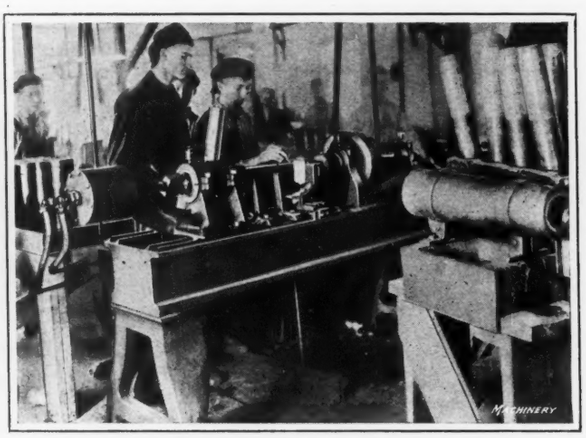


Fig. 9. Crimping Cartridge Case onto Shell

threads are cleaned out, as indicated in Fig. 7, by the shell being placed on rollers and rotated by hand, while a sharp pointed tool bent at the end similar to a thread boring tool is inserted into the threads to remove the T.N.T. that has been lodged in them. After the threads are cleaned, the operator moves the open end of the shell up into the duct shown to the left. The small piping indicated in the center of the duct blows compressed air into the cavity of the shell, while suction is provided through the large duct, so that all the dust is removed. After the booster cavity has been bored and the threads cleaned, the inside of the cavity is shellacked, the shell being placed on rollers, as indicated in Fig. 8. These rollers are mechanically rotated while a spraying gun coats the inside of the cavity with shellac. The shell is pushed off the rollers by means of an ejector operated by a foot-treadle, and a new shell rolls into place on the rollers without the operator's aid.

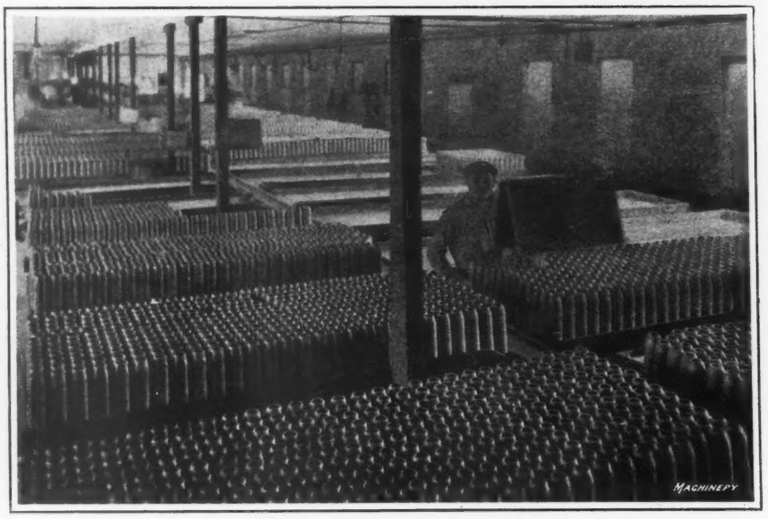


Fig. 10. Shells sorted according to Weight

Weighing and Sorting Shells

The shells are now weighed in order that they may be sorted into different classes according to the weight of the shell and the explosive charge. Fig. 10 shows the sorting tables upon which the shells are placed after having been weighed. In the middle of the room is a belt conveyor, as shown, upon which the shells pass from the scale, and from which they are picked up by the sorters and placed upon the tables. Every lot of shells sent out from the factory must belong to one single weight group, in order to meet the requirements of the gunners on the firing line.

Assembling Shell and Case

From the storage tables, the shells pass to the assembling room. Here they are first placed into a simple vise having semicircular jaws for holding the shell while the booster is put in place. They are then put onto a conveyor which carries them to the assembling machines where the brass cartridge case is crimped onto the end. The cartridge cases with the proper charge of smokeless powder come to this machine by a conveyor from another part of the factory. Before being placed in the assembling machine shown in Fig. 9, the end of the shell below the copper band is greased, the grease being kept in a molten condition and put on with a brush. The object of this grease is to provide a waterproof joint between the case and the shell.

For the assembling, the shell is placed with its nosed-in

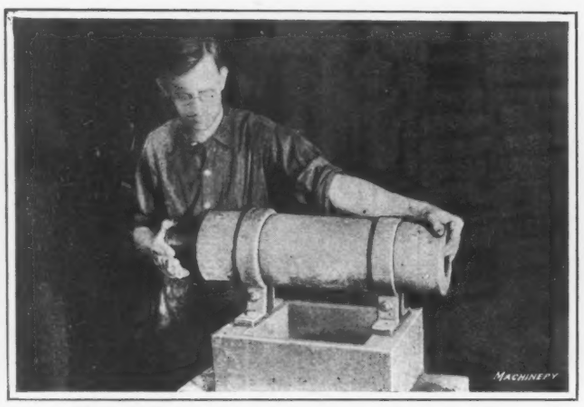


Fig. 11. Gaging Shell and Cartridge Case in a Gage which is an Exact Reproduction of Chamber of Gun from which Shell is fired



Fig. 12. Painting Shell with Spray Gun to protect it against Weather Conditions and to form a Background for Stenciling

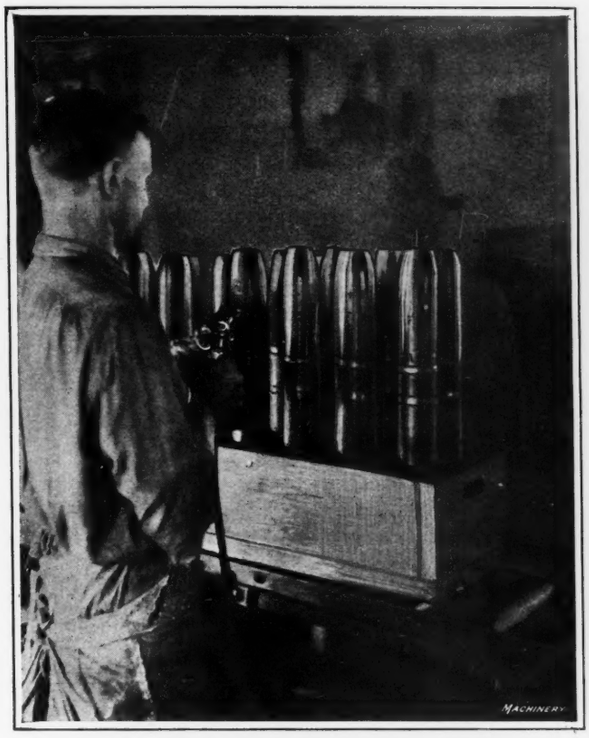


Fig. 13. Marking Shells with Stencil and Spray Gun

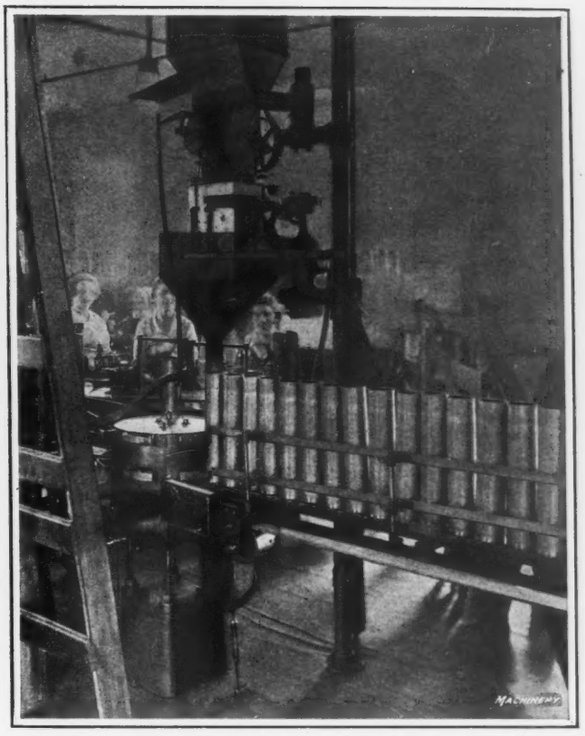


Fig. 14. Automatic Smokeless Powder Weighing Machine

end in a conical recess in a chuck at the headstock end of the machine, while the end of the brass case fits into a small cavity in the tailstock. Pressure is then applied by means of air on a piston in a cylinder at the outer end of the tailstock, as indicated in the illustration; this forces the tailstock forward and with it the cartridge case onto the end of the shell. At the same time, rollers operated by a foot-lever are brought to bear upon the end of the cartridge case for producing the required pressure for crimping the case onto the shell. The grease pressed out at this time is cleaned off by the operator with a small wooden knife. The completed shell with its case immediately upon being removed from the assembling machine is passed to the inspector, who places it in a chamber gage as shown in Fig. 11. This gage is provided with a bore which is identical with that of the chamber bore in the gun from which the shell will be fired, and gages the copper band, bourrelet, and the rear end of the brass case. If the shell will pass into this gage, it is also sure to fit the gun.

Painting and Finishing

The shells are now placed on end in wooden boxes, eight shells to a box, and passed on conveyors to the painting and finishing room. They are there placed in a machine similar to a small lathe and painted by a spraying gun, the projectile end only being painted in this way, as shown in Fig. 12. A suction draft is provided for carrying off the paint fumes. From the painting machine the shells pass to the stenciling operator who marks them with the mark and number as indicated in Fig. 13. The marks are black on a yellow background. The marking is done very rapidly by means of a stencil and a spraying gun. After this, a small felt plug is put into the booster at the place where the fuse will later be inserted, and then the shells are placed in heavy paper tubes provided with a sheet-iron bottom. The shells are put into these tubes nose first, and a cap is placed on the other end, this cap being crimped onto the paper tube. The cap is provided with an inside washer having a cavity over the primer in the shell in order to protect the primer from accidental shocks or blows. The top of the paper tube with the cap in place is then dipped in tar for waterproofing.

The shells are then packed in boxes, nine shells to a box, and the boxes are carried by a conveyor to the finished storehouse, ready for shipment. Fig. 18 shows the type of boxes in which the shells are packed ready for shipment. These boxes are now ready to go to France.

Loading Cartridge Cases

The cartridge cases are supplied to the factory completely drawn and finished, but the primers are not in position. The latter are also supplied to the factory complete, ready to be inserted in the cartridge cases. Fig. 15 shows the use of an arbor press for pushing the primer into position in the cartridge case, after which it is stamped on the base with a lot number, as indicated to the right in the same illustration. Two men are engaged in the work of inserting the primer, one putting it into position and the other operating the press. After having been stamped, the cartridge cases pass in an upright position on a conveyor into the room where they are loaded with the smokeless powder. The conveyor and the manner in which the cartridge cases pass

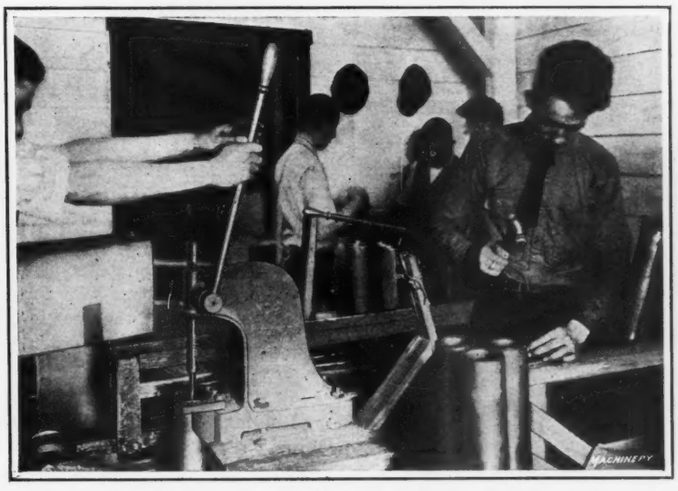


Fig. 15. Putting Primers into Cartridge Cases before the latter are charged with Smokeless Powder



Fig. 16. General View of Room in which Charge in Cartridge Case is Twice weighed for Checking Purposes

into this room are shown in Fig. 14. They then pass underneath the automatic weighing machine shown in the center of this illustration, where a predetermined amount of smokeless powder is discharged into the cartridge case from a hopper above. The cartridge cases pass automatically onto the weighing machine, which has a revolving table, as indicated. This table is indexed so that each cartridge case is held directly underneath the spout of the hopper for the period required for depositing the smokeless powder. It then indexes around and brings a new case underneath the spout of the hopper. The cases are then automatically removed from the revolving table or turret of the weighing machine and pass along a conveyor, from which they are taken and placed upon a large revolving wooden table, indicated in the center of Fig. 16, the post shown being the shaft about which this table revolves. Around this circular table are stationed the inspectors who weigh the charge of smokeless powder to see that it is exactly right. These inspectors are girls who work in pairs. The girl next to the table is the company's inspector and the outside girl is the government inspector. Each of these girls empties the charge from the case onto the scoop of an accurate scale and weighs the charge. The company's inspector adds or removes one or more pellets of powder in case this is required, and then puts the charge back again into the cartridge case. The government inspector pours out the charge again into the scoop of her scale and check-weighs it. At this time, it must be found correct within the limits allowed, which are very narrow. A near view of the two inspectors is shown in Fig. 17. The company's inspector to the left is adding a few pellets in order to make up the correct weight. The government inspector to the right is putting back a charge into the case after it has been found correct.

The cases are now put into the boxes on the conveyor shown in the background of Fig. 17. A sheet-iron cap is placed over the open end of the shell in order to prevent spilling the powder. The shells then pass on a conveyor to the assembling department.



Fig. 17. Girls engaged in Check-weighing Charges in Cartridge Cases

ESSENTIAL INDUSTRIES

An inquiry directed to the War Industries Board in Washington has brought forth the following reply with regard to the definition of "essential industries" at the present time:

Plants engaged exclusively in manufacturing aircraft or supplies, ammunition for the United States and the Allies, large guns, small arms for the United States Government and the Allies, chemicals and coke.

Plants manufacturing electrical equipment, electrodes, explosives, agricultural implements, farm operating equipment, feed, ferro-alloys, fertilizers, and firebrick.

Plants manufacturing, milling, preparing, refining, preserving and wholesaling food for human consumption; and those manufacturing tin and glass containers and other food containers.

Gas-producing plants and those manufacturing exclusively gas-producing machinery, hemp, jute and cotton bags, insecticides, and fungicides.

Iron and steel blast furnaces and foundries; steel plants; rolling mills; plants making machine tools; mines and plants engaged exclusively in manufacturing mining tools and equipment; refineries of mineral and vegetable oils; plants making exclusively oil-well equipment.

Public institutions and buildings; public utilities; railways; plants manufacturing locomotives, freight cars, rails, and railway supplies; food refrigeration and exclusively ice producing



Fig. 18. Shells packed in Boxes Ready for Shipment; Nine Shells to a Box

plants; laundries; producers or wholesalers of seeds (except flower seeds).

Ships (bunker coal), not including pleasure craft; plants engaged exclusively in building ships (not including pleasure craft) or in manufacturing exclusively supplies and equipment therefor; manufacturers of soap.

Tanning plants, save those for patent leather, and those manufacturing tanning extracts; manufacturers of tin plate; plants producing exclusively binder twine and rope and those making wire rope and rope wire.

* * *

INCREASING POWER PLANT EFFICIENCY

The United States Fuel Administration has appointed Henderson W. Knott to manage the field force of engineers and inspectors that is at work among the power plants of the country. Mr. Knott has been the general manager of the Morgan Crucible Co. of New York City and his appointment is a part of the plan, originated by David Moffat Myers, advisory fuel engineer of the Fuel Administration, to have each of the 250,000 steam plants in the United States visited by a competent man who can make suggestions and report in connection with the questionnaire originated by Mr. Myers. This field force will be organized by states in order to give it greater efficiency.

* * *

Dipping steel springs in molten tin prevents their becoming brittle when electroplated. Uncoated springs become brittle during the electroplating process. Sulphuric acid pickling baths also greatly decrease the flexibility and the elasticity of iron wire and steel springs.

FACTORY INVESTIGATIONS

REASONS FOR EMPLOYING OUTSIDE EXPERTS AND METHODS OF CONDUCTING INVESTIGATION

BY ALBERT A. DOWD[1]

If the superintendent of a factory feels indisposed and does not know just what is the matter with him, he seeks the advice of a physician in order to determine what is wrong and obtain suitable remedies. Many manufacturing firms are finding that their factories are not producing the work as rapidly or as accurately as they should; but instead of consulting one who, like a physician, has made a special study of such cases, these firms seek to determine the reasons for this condition themselves. It is difficult for them to do this for the same reason that a sick man cannot diagnose his own case. In the first place, the superintendent is too close to the work to view it broadly; besides, he cannot look into all the details connected with the product of his factory. Undoubtedly an investigation would show him where some of the trouble lies, but he has not the time to study these matters and at the same time keep in touch with the thousand and one things that must be attended to by a man in his position.

Factory superintendents usually assume a hostile attitude toward any outside investigation by a specialist for the following reasons: the cost of the investigation, due to the high compensation demanded; the possibility of causing labor troubles in the factory, due to the interference and suggestions of an outside party; the interruption of production; the cost of changing methods, tooling, and the like in order to increase production; the unfortunate experiences of many firms with so-called "efficiency engineers"; and the belief of the average factory superintendent that he knows more about his own production and the best way to manufacture it than any outside man can tell him.

The main question, however, is: Can a mechanical expert go into a factory, with the product of which he is unfamiliar, and after making a thorough investigation show the manufacturer ways in which he can improve the production and save money? The writer has been engaged in this work for various factories and has found that with proper cooperation by the management, and a receptive attitude on the part of the foremen, many improvements can be made to stimulate production. In many cases the changes necessary are not costly and can be instituted without interfering with the production in any way.

Place for Beginning Investigation

The investigator must enter a factory with an open mind and must consider the entire factory as a problem to be solved. He should start the investigation in the assembling department. In this way he will become familiar with the product in its finished state, and will see why certain parts must be made more accurately than others in order to facilitate the assembling. Besides, various points can be noted in connection with the assembling and fitting that will aid in locating inaccuracies during the machining processes. These points can then be traced to their origin and notation made as to improvements needed. For example, if it is noted that certain parts will not fit together properly and so must be taken off and dressed with a file or otherwise fitted, it is evident that there is something wrong with the method of machining or that the inspection department is at fault. The methods used in the assembling department vary greatly and in some cases manufacturers are lax in providing suitable assembling stands and fixtures, so that a man must take a great many unnecessary steps. The engineer can make notations of all these matters, and study them in detail later.

When the engineer has studied the assembling and fitting departments, his next step should be to take up the points noted, one at a time, in the various departments where the machining operations are accomplished. When tracing the operations, from the time the product leaves the rough stock room to the time it reaches the assembling department, he may find that considerable time is lost by frequent handling and that some pieces of work take a certain routing while other parts are routed in an entirely different manner without any apparent reason. A case of this kind was found in a factory using flat and round stock. The flat stock was cut to size by a shear in the rough stock room; but the round bar stock was placed on a hand truck and taken into another part of the main factory to be cut. Not only was the round bar stock difficult to handle on a truck, but, during the cutting operation, the truck obstructed a passageway. Yet, there was no reason why the shear for the round stock could not be moved into the stock-room and the bars cut up in this department, the same as the flat pieces.

Faults Found in an Automatic Screw Machine Department

Another case recently noted was in an automatic screw machine department, which was exceedingly well equipped with machines capable of turning out work to good advantage; but though the machines were working continuously the production was nowhere nearly what it should be. An investigation showed that the camming of some of the machines was very bad; in one case, the idle time on a machine producing one piece of work every sixty-five seconds was found to be twenty-five seconds when it should not have been more than five or six seconds. It was also found that the machines were not speeded up to their greatest efficiency and that the drills were ground at an angle that did not permit the best results to be obtained. Furthermore, the operator did his own drill grinding for six machines, and had no set of duplicate tools nor any method but a makeshift sort of gage by means of which he could set the tool, after it had been ground, to the proper position. The job was a very simple one, requiring only a drilling, facing, forming, and cutting-off operation on a piece of cold-rolled stock. By improving the camming of the machines, providing duplicate tools and simple sheet-metal gages by means of which the tools could be set, and increasing the speeds of the machines slightly, the production was increased over 40 per cent without any appreciable cost.

There seems to be a tendency on the part of those using cutting tools, especially automatic screw machine operators, to keep the frequency of tool grinding down to the minimum. In the case cited, the cutting tools were ground about twice a week, and the operator seemed to think that he was obtaining very good production and that the efficiency of the machine was shown by the fact that the tools did not need to be ground oftener. As a matter of fact, if a tool that is put to hard service requires grinding only once in three days it is evident that that particular tool is not doing its utmost work. Naturally the operator does not wish to grind tools oftener than he is obliged to, on account of the difficulty of resetting them so as to produce the work correctly. However, if a set of simple sheet-metal gages is made up and a duplicate set of sharp tools is kept in a convenient place, the matter of grinding becomes a much less serious proposition and the machines can be run to maximum efficiency and produce the work properly.

Matters of this kind are very likely to be overlooked by the superintendent, and as long as the machines themselves are running steadily and producing a certain quantity of work that is commercially acceptable, he is not likely to think much about this department. As a matter of fact, in the case cited, if an investigator had been engaged a few months sooner it might have been unnecessary to buy two new machines, because the production would have been sufficiently increased without them.

Increasing Production by Overhauling Machines

About a year ago the writer was investigating conditions in a factory in New England, producing a press that had a platen varying in size from 20 by 30 inches to 36 by 48 inches. The investigation started, as usual, in the assembling department, where it was found that from three days to a week was consumed by the man in scraping and otherwise fitting some of the parts. Frequently the scraping of the platen consumed several days before it was in suitable shape. Tracing this piece back, it was found that the planing machines used were in very bad shape. There were twelve planers in the factory, so these were torn down one at a time, and the var-

[1]Address: Care of Service Engineering Co., 25 Church St., New York City.

ious working parts and the table were refitted so that the machine produced the work within reasonable accuracy. Of course, this refitting of the machines cost considerable money and held up the work on that particular machine during the process, but the time required to assemble the machine and do the necessary fitting on the platen was greatly reduced.

The examples noted are typical of things that may be found by an investigator, but which would not otherwise be noted, and a factory may be operated for months with a considerable loss in production before the actual causes of the loss are discovered. It must be remembered, however, that any engineer who undertakes an investigation must be a man of wide experience, who is able to analyze the various conditions in the factory as he finds them and suggest suitable remedies. The prevailing opinion among manufacturers is that if an outside investigator were to visit their factory he would be likely to do more harm than good. It is unfortunate that this attitude has become prevalent and the engineer investigator must live down this reputation. He has come to stay, and conditions in the manufacturing field at present confirm the belief that more and more of these men will be required as their value becomes appreciated. Some manufacturers prefer to do their own investigating and have a man for this purpose in their organization; but this system does not work satisfactorily for the reason that the viewpoint of this man is too narrow, and he does not obtain the desired results because he is too closely in touch with the work.

* * *

CONVERTING MOTOR ARMY TRUCK INTO LATHE FOR TURNING WOODEN SHELLS

At Camp Lee there developed recently an urgent demand for three hundred 3-inch "wooden shells." These shells, which were to be used in maneuver work and had to be completed in two days, were to represent a 3-inch shell and cartridge case. As there was no lathe or tool equipment of any kind at the camp adapted to wood turning, it was considered an impossibility to produce the shells at the camp, until Sergeant Carlson, who is a very resourceful mechanic, undertook the construction of a special "wooden shell" turning lathe.

The only available supply of material that could be used for constructing this lathe was a partially dismantled automobile army truck, from which parts had been removed to repair similar trucks. Fortunately, the motor and the transmission case had been left intact and were in serviceable condition. With parts taken from the motor truck and by the aid of a few crude tools from the blacksmith shop, the lathe shown in Fig. 1 was built and put into operation. The lathe bed is constructed from wooden plank supported between two wooden posts. The transmission case of the motor truck is mounted on this base and made to serve as the headstock.

The transmission case shaft equipped with a flange coupling for connection with the universal joint of the motor driving shaft is used as the spindle, and the flange coupling is made to serve as a faceplate. The emergency brake drum on the transmission shaft serves as a pulley and is driven by a belt from the fan-belt pulley on the motor truck engine. The tailstock center is made from a piece of threaded round iron, obtained from the blacksmith shop. This rod is screwed in the post in line with the improvised faceplate and the end is bent to form a crank, so that it can be turned in or out, the same as the ordinary tailstock center. The tools for turning were made from old files at the blacksmith shop.

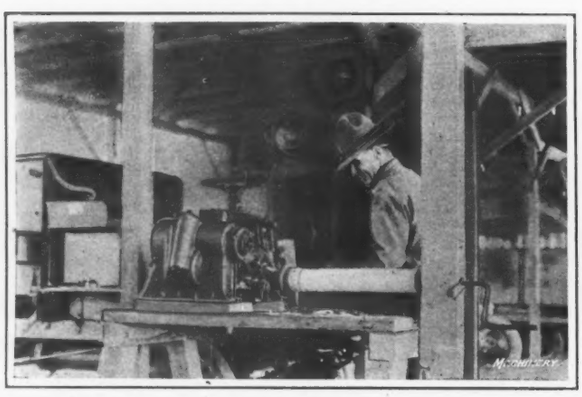


Fig. 1. Lathe first designed for turning Wooden Shells

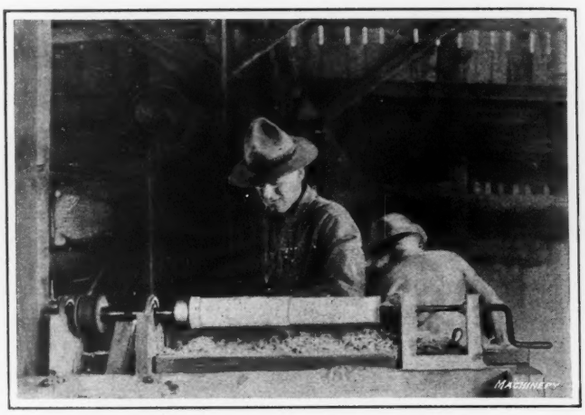


Fig. 2. Improved Type of Lathe for turning Wooden Shells

This lathe was not entirely satisfactory, however, and the inventor proceeded to improve upon the original design. The lathe which was finally evolved is shown in Fig. 2. This improved type was found entirely satisfactory, and evidence of this fact is clearly shown by the expression on the face of the operator. The main spindle is equipped with ball bearings and was removed from the transmission case of the dismantled car. The tailstock center is the one employed in the original lathe, but is provided with a new type of holder, as shown. The main spindle, which is equipped with a wooden pulley, is belt-driven from the fan-belt pulley on the truck motor.

One of the interesting facts in connection with the development of this lathe is that the time required in designing and constructing was only one day, and the rate of production of wooden shells on this lathe made the delivery of the 300 shells possible within two days' time.

* * *

AMERICANIZATION—A VITAL PROBLEM IN THE INDUSTRIES

The Chamber of Commerce of the United States has published a booklet entitled "What You can do for Americanization," which is being widely distributed among the industries. In this booklet, manufacturers are requested to take steps to imbue foreign-born men and women thoroughly with the American spirit and assist them in becoming American citizens. Among the suggestions given are the following: See that the safety, sanitation, and housing of your men are such as to keep them fit during the war. Every man or woman who does not speak English should be learning it. Insist upon their learning it in school or in your shop, and designate one of your employes to see that it is done. Urge the public educational authorities to start language classes in the factory for those who do not understand English and are unable to attend school. Efficiency increases with knowledge of English and citizenship. Give it recognition by increased wages and promotion. Stop anti-American propaganda and agitation in your plant, by providing information and cooperation on true Americanism. Invite naturalization officers to explain citizenship to your aliens and encourage them to make America their home. Give them time off with pay to attend to their naturalization examinations. Develop incentives through wages, bonuses, insurance pensions, and profit-sharing. The employer who keeps his men at work contentedly today is America's most practical patriot.

* * *

An alloy that is very ductile, resistant, and flexible is formed by combining tantalum with small proportions of gold and copper. After the metals are reduced to a fine powder and mixed, the mixture is subjected to pressure and the compact mass thus formed is fused in an electric furnace. The alloy is as non-oxidizable as pure tantalum, and can be produced at a reasonable price.



Methods of Trademarking Your Product

By Edward K. Hammond[1]



Functions of Trademarks and How to Apply Those Possessing the Maximum Durability and Publicity Value

IT can be said without fear of contradiction that a trademark which is placed on any metal product in such a way that the marking will not become obliterated or invisible from wear, discoloration, etc., constitutes a perpetual advertisement for the manufacturer during the entire working life of the machine, tool, or other product upon which the trademark is applied. Any manufacturer makes a great mistake in not placing a trademark on his product, together with his name and address, for such a marking is frequently the means of securing repeat orders. It is quite a common matter for shop men to be asked by the purchasing department of a plant to give their opinion of the relative merits of two competing products between which the purchasing agent is anxious to make a decision in issuing subsequent orders.

In order to illustrate this point, let us suppose that the foreman of the grinding department in the factory has been asked by the purchasing agent to give his opinion of the relative merits of two different types of grinding-wheel truing tools in use in the shop. At the time each of these tools is received, the usual form of invoice doubtless comes with it, but after the details of payment have been settled, it will often happen that the wheel-truing tools go from the receiving room to a supply room and thence to the shop, where they will simply be identified as wheel-truing tools without any connection to the manufacturer's name. If the tools are clearly trademarked, the shop foreman will have no difficulty in identifying the particular tool which his experience has shown to possess the most points of merit under actual conditions of service, and so he will be able to make a definite recommendation to the purchasing department, which will assure more of these good tools being purchased for his use. But if the tool carries no trademark, or if it is marked in such a way that the design will be obliterated shortly after the tool has been placed in use, it is very difficult for the man in the shop to state definitely which tool he has in mind, as a result of which mistakes are likely to be made in identifying the tool that the foreman referred to, which results in the loss of repeat orders by the manufacturer who has actually made the tool that should have been given preference.

In order to possess the maximum publicity value that is available, a trademark should have some peculiar significance in connection with the product to which it is applied, in order to connect the trademark with the product and cause the marking to be readily remembered. For instance, the Simmons Hardware Co., of St. Louis, Mo., has adopted the trademark of "Keen Kutter" for various types of edged tools which are produced in its factory. Obviously, this name will very easily be associated with cutting tools, and so, if a foreman in any factory where these tools are used wishes to suggest their purchase for use by men employed in his department, it will be very easy for him to tell the purchasing agent that these "Keen Kutter" tools have given exceptionally satisfactory service.

Use of Trademarks in Advertising Literature

After he has been successful in developing a trademark which is properly linked with the product on which it is used, the manufacturer should follow the scheme to its logical conclusion by making free use of his trademark on letter heads, advertising literature, etc. The idea of a trademark is to advertise the product on which this mark is placed, and maximum results are only obtained by persistently endeavoring to make the trademark synonymous with the product on which it is placed, so that a prospective customer who is in the market for the product in question will immediately connect the well-advertised trademark with the particular type of tool or equipment which he wishes to buy. It is a matter of general knowledge that trademarks can be registered in the United States Patent Office, so that the manufacturer who is the maker of well-known trademarked products is protected against the use of his trademark by competitors. It costs very little to apply trademarks on most manufactured products, and they may become very important factors in conducting the work of the sales department.

Importance of Durability of Trademarks

Reference has already been made to the importance of having a trademark applied in such a way that it will possess the necessary durability to be plainly visible during the entire working life of the tool. Unless care is taken to obtain this result, nothing approaching the maximum publicity value which is available can be expected from the trademark. For instance, consider the case of a manufacturer of wooden-handled tools who adopts the practice of marking them with a colored paper label pasted on the handle. Such a method of marking constitutes a highly efficient advertisement for a short length of time, because the label can be printed in bright colors, which naturally attract attention. It is fairly obvious, however, that these labels can only last for a very short length of time, because if they are not torn or worn off the product on which they are applied, discoloration will soon make them unreadable. On the other hand, if the trademark, maker's name, etc., is impressed in the metal surface or applied by some process which leaves the required design and maker's name, etc., raised above the surface of the metal surrounding the marking, each trademark will last for the entire working life of the tool, thus giving continuous service as an advertisement of this particular type of tool.

In deciding upon the best method to use for trademarking a given product, several factors must be considered. First of

[1]Associate Editor of MACHINERY.

all, it is necessary to obtain a design which is as characteristic as possible of the particular product on which the trademark is to be applied, and next in order is the importance of selecting a method of applying this marking to give a neat and workmanlike appearance. In connection with the selection of a method of applying the trademark, consideration must be given to the conditions under which the product is used on which this trademark is to be applied. In any case, the ultimate object which is desired is to keep the trademark in a

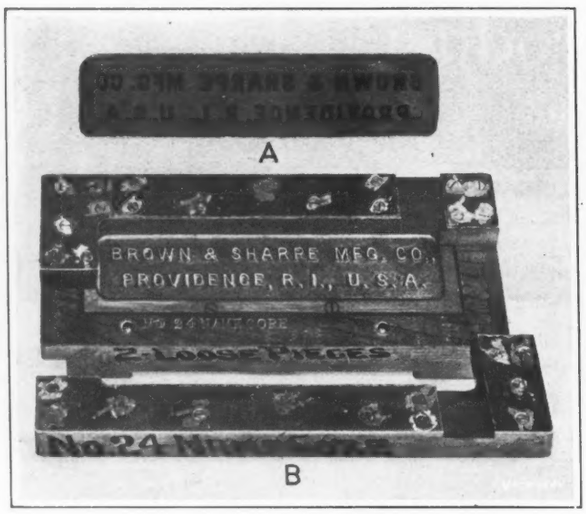


Fig. 1. (A) Core for casting Marking on Machine Tool Frame and (B) Core-box in which Core is made

condition which makes it plainly visible during the entire working life of the tool. Such being the case, it would obviously be unsuitable to stamp a trademark into the surface of a machine tool frame which will become coated with oil and dirt. A trademark applied by such a method would very soon be obliterated, with the result that the manufacturer of the machine would fail to secure his full quota of publicity from the trademark. This is one reason for adopting the almost universal practice of making the mold in which the frame casting is produced in such a way that the trademark, manufacturer's name, etc., are cast in letters which are raised sufficiently above the surface of the metal so that they are not likely to become invisible.

Various Methods of Trademarking

The manufacturer who is about to make a selection of the method of applying a trademark to his product will naturally be interested in reading the following brief description of the different methods by which trademarks are applied to a variety of metal products. For marking machine tools with the builder's name and address and any special name or legend which has been adopted to identify the tools of his manufacture, it is almost universal practice to cast the required marking directly upon the machine bed. For this purpose, a core on which the necessary lettering, etc., is produced is set in the mold in which the casting is to be poured and left protruding sufficiently to cause an indenture upon which the raised letters appear. This indenture brings the surface of the letters flush with the surface of the machine bed, thus avoiding any tendency for the letters to be worn or broken off. Fig. 1 shows at *A* one of the cores used for casting the required marking on the frames of machine tools built by the Brown & Sharpe Mfg. Co., of Providence, R. I., and at *B* there is shown the core-box which is required for use in making these trademarking cores. Fig. 2 shows a machine frame marked in this way.

A substitute for the method of casting a name right on a machine bed is to apply a nameplate made of brass or some similar metal. A nameplate has one important advantage over the name cast onto the machine bed in that it is made of a different colored metal, and so perhaps attracts more attention. However, the nameplate is a trifle more expensive to apply, and there is also the risk of its becoming detached from the machine. In any case, where a nameplate is to be applied to a machine or other product of considerable size, the design of the product to be marked should be studied with the view of selecting a position for the nameplate which will combine the advantages of having it protected from unnecessary wear and still having it so placed that it is readily seen by those who operate the machine or pass by it. Nameplates may be of various forms, but in all cases the metal from which they are made should be sufficiently hard so that the lettering will not be bruised or worn smooth, and to further assure against the production of such an undesirable condition, the letters should have plenty of relief.

Nameplates are made in a number of different ways, among which mention may be made of the processes of casting the plate in a mold, or of producing the required legend and design by etching, lithographing, or embossing. Nameplates made by each of these methods have certain points to commend them. The chief claim made for the cast nameplate is that almost any desired amount of relief can be provided for the letters and other elements of design. Cast nameplates are likely to be rather expensive, owing to the necessity of making patterns and molds, but this limitation has been considerably reduced through a method developed by the Federal Nameplate & Novelty Co., of Chicago, Ill. This firm has developed a process for making die-cast nameplates in sectional molds, which are built up by assembling the necessary combination of letters, spaces, border lines, etc., each letter, spacing block, or section of border being carried on an individual steel block which is carefully machined on all sides so that any required number of these blocks can be assembled together and form a tight fit. The great advantage of this method of making nameplates is that standard die sections may be carried in stock by the nameplate manufacturer, in the same way that a printing plant carries different standard type faces in stock. Then when an order is received for, say, two hundred nampelates of a given design, the necessary die sections can be taken from the racks and assembled to form the die required for casting these nameplates. After a given order has been completed, the die is broken up and the die sections replaced in their respective positions in the racks, so that the only die charge which need be made against a given job is the average wear and tear on the die sections used

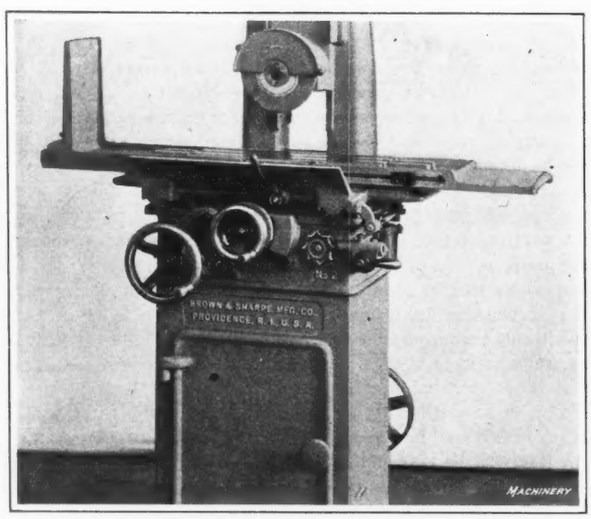


Fig. 2. Marking on Machine Frame produced by Use of Core shown in Fig. 1

in handling the work. This method is naturally the means of making a great saving in the cost of production, because to make a special die for die-casting, a small number of nameplates must of necessity add greatly to the expense, as the whole cost of the die has to be distributed over a small number of plates.

Making Etched Nameplates

A great many nameplates used on different types of small machines and metal products are made by etching the legend

and design on the metal plate. For this purpose, the method of procedure used in manufacturing nameplates is as follows: A drawing of the required design is made to an enlarged size in order to enable the artist to work more easily. A zinc etching of the required size is then made from this drawing by the photo-engraving process. The etching is set up in a special form of printing press and the design of the required nameplate is printed on the surface of sheet-brass blanks from which the nameplates are to be made. While the printed surface is still wet, a specially prepared acid-resisting chemical powder is shaken over the surface of the sheet brass, and this powder sticks to the wet parts of the blank, while it may be easily brushed off those sections of the brass surface which are left clean. The work is now ready to be etched, for which purpose it is treated with acid that eats its way into the exposed surfaces of the brass but will not "cut" the portion of the surface which is provided with the specially prepared "resist" that was applied by the printing operation. The amount that the design is left in relief will be governed by the length of time that the brass is exposed to the etching acid, but after the desired result has been obtained, the acid is washed off with clear water.

Fig. 3 shows a variety of etched nameplates made by the Crowe Nameplate Co., of Chicago, Ill. This firm has specialized in the making of etched nameplates and has developed processes for obtaining a variety of different color combinations. For instance, plates may be made of white metal, brass, copper, etc., with the combination of bright letters and a frosted background, or vice versa; also, colored plates may be made with the background in various colors and the letters in the natural color of the metal, etc. Such color schemes add greatly to the effectiveness of the nameplate from a publicity standpoint. Other colored nameplates are made by a process of lithographing on sheet metal which enables any required combination of colors to be obtained. One serious limitation of the lithographed nameplates is that they do not stand up very well under severe conditions of service. Two examples of nameplates made by the lithographic process are shown at *A* and *B* in Fig. 4, and at *C* there is shown a plate on which the letters were raised on the sheet metal by an embossing die.

Etching a Trademark upon the Product[1]

There are various metal products, of which cutlery is an example, that may be effectively trademarked by etching di-



Fig. 3. Examples of Different Combinations of Letters and Backgrounds on Etched Nameplates made by the Crowe Nameplate Co.

rectly upon the surface of the metal. In the case of steel or iron products, nitric acid may be used as the etching medium, and this acid oxidizes the iron, leaving the etched surface black, so that it stands out in distinct contrast with the light colored surface of the surrounding metal. As in the case of making etched nameplates, the principle governing the process of etching directly upon the surface of the metal product is to apply a resist in which the required design is cut in order to expose the metal to the action of the etching fluid, while the surface of the metal surrounding the marking it is desired to etch is protected by means of the resist. The method of procedure in handling the work is somewhat different, however.

One way of etching trademarks on cutlery which has been found to give satisfactory results is to apply a light coat of shellac on the surface in which the trademark is to be etched.

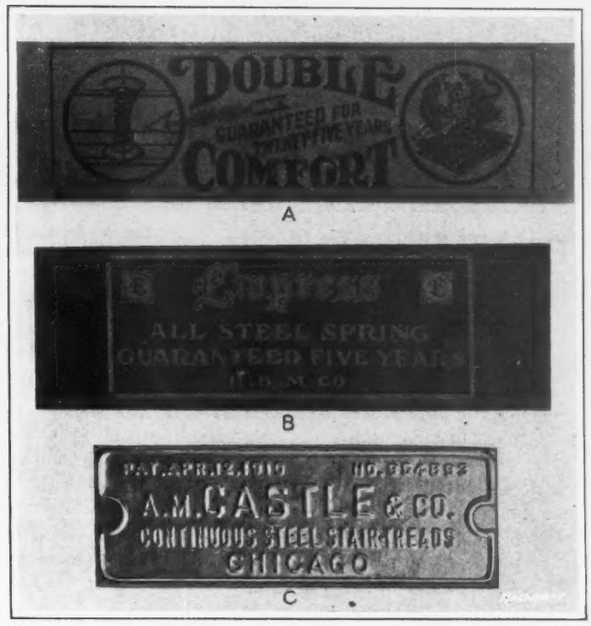


Fig. 4. (A and B) Nameplates made by the Lithographic Process and (C) Nameplate with Letters embossed on Sheet Metal

A rubber printing stamp is made with the required trademark, and this stamp is first applied to a pad saturated with caustic soda and then pressed on the shellac, which has been given time to dry on the metal surface to which it was applied. The result is that the caustic soda applied by the rubber stamp "cuts" the shellac, so that it can be removed by lightly brushing the surface with water. When 20-per-cent nitric acid is applied, it will etch that part of the steel surface which has been exposed by cutting the trademark in the shellac, while the remainder of the surface is protected from the acid by the shellac. The acid is left on the work for about eight minutes, although the exact time varies considerably, according to the composition of the metal. After giving the acid time to etch the trademark on the work, the entire surface is rinsed in cold water in order to wash away the excess acid and prevent further action. Various other methods of applying a resist and cutting the required design in the resist to expose the surface of the metal for etching may be employed, but the method of using a rubber stamp and caustic potash to expose the metal under a shellac resist is perhaps one of the most rapid and effective that can be employed.

Etching Trademarks on Tools

At the plant of the Nelson Tool Co., 781-783 E. 142nd St., New York City, a practice is made of etching the company's name on dies and other tools made in the shop. For this purpose, the method of procedure involves the use of the usual combination of a resist and etching fluid, but the way in which the work is done has certain interesting modifications. Beeswax is used as a resist, and the wax is applied to the metal by heating an iron bar about ½ inch in diameter in the flame of a Bunsen burner and rubbing this bar over the surface of a cake of wax about 2 by 4 inches in size. Application of the hot iron bar warms the wax so that it approaches a melted condition; the warmed side of the wax is then rubbed over the surface of the tool which is to be etched. This leaves a film of wax on the surface of the tool which is impervious to the action of the acid used for etching. After the wax has been given sufficient time to cool and harden, a steel scriber with a

[1] In the September, 1917, number of MACHINERY there was published an article entitled "Graduating, Engraving, and Etching." This article gave detailed information concerning various resists and etching fluids suitable for use on steel, iron, brass, etc.



Fig. 5. Method of applying Wax for etching Trademark



Fig. 6. Method of engraving Marking for Trademark in Wax

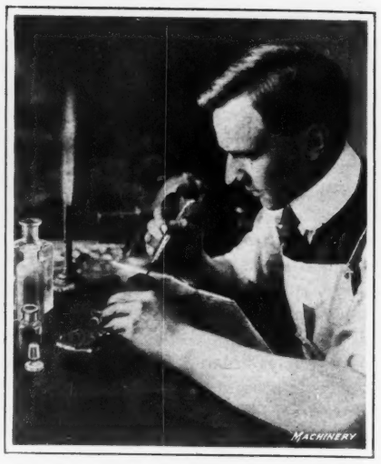


Fig. 7. Method of applying Acid for etching Trademark

sharp point is used to make the desired marking, with the result that the wax is cleared away from the surface of the steel, leaving the metal under the marking exposed but the surrounding surface of the steel covered with wax.

An etching fluid consisting of four parts of hydrochloric acid to one part of nitric acid is then applied to the steel. The exact length of time which the acid stands on the work will vary according to the composition of the steel and certain other conditions, so that it is necessary to experiment in order to determine the exact length of time which gives the desired depth of etching. Usually, the time required will be from five to ten minutes. It varies according to the composition of the steel and whether it is hard or annealed. After the acid has been left on the work for the required time, it is washed off with water, after which the wax resist can be removed. The marking produced on steel by an etching fluid containing nitric acid is of a dark brown or black color, which shows up distinctly on the light colored surface of the steel. The reason for the etched marking being black is that nitric acid is an oxidizing agent, the etching process consisting of the conversion of light colored metallic iron into iron oxide which is nearly black. Figs. 5, 6, and 7 show successive steps in etching trademarks on tools as done by the Nelson Tool Co.

Robinson's Etching Solution

The following formula for an etching solution for etching lettering on carbon or high-speed steel was developed by J. B. Robinson, of the Rochester Ball Bearing Co., while employed at the Bausch & Lomb Optical Co., Rochester, N. Y., and has been termed the "Robinson formula." It consists of 2 parts of acetic acid, 8 parts of nitric acid, and 5 parts of hydrochloric acid. Beeswax is used as a resist, the wax coating being rubbed onto the object to be etched very thinly and smoothly, preferably by using the edge of a scale or similar object. The acid is permitted to act for about two or three minutes, with a fresh mixture, and produces a black deposit in the etched lines. It is claimed that this solution gives very satisfactory results, and those who have used it recommend it highly.

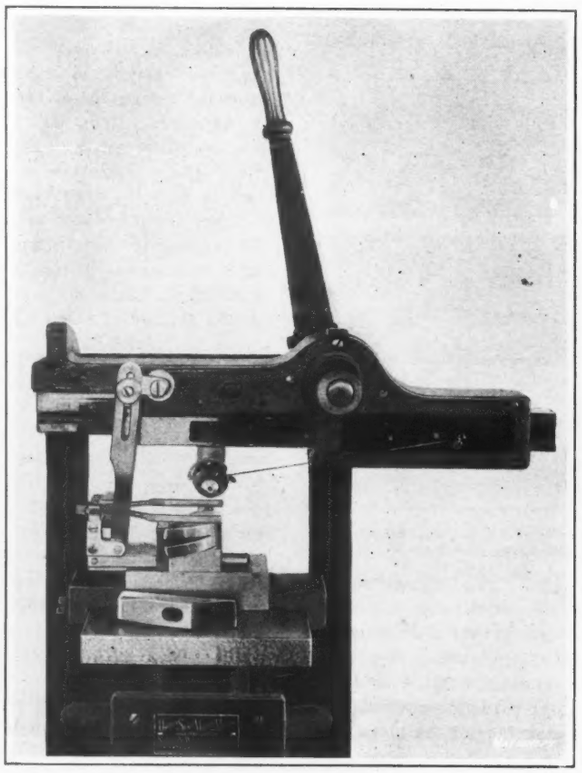


Fig. 8. Dwight Slate Marking Machine equipped for impressing Trademark in Flat Work

Decalcomania Transfer Method of Etching

For etching trademarks on metal products, use is often made of decalcomania transfers, which are perforated so that they form a background for the trademark, thus constituting a resist which protects the metal surface while the desired marking is left exposed so that it may be etched by the fluid which is applied for that purpose. There are various methods of applying decalcomania transfers for etching, but the following is one that has been found to give satisfactory results: The face of the transfer is given a thin coat of quick-drying varnish and allowed to stand until the varnish becomes very sticky or "tacky," as it is called. The varnished side of the transfer is then applied to the work to be trademarked and the transfer is rolled with a rubber roller to expel air bubbles and get the transfer firmly in contact with the work.

After allowing the varnish a few minutes to set, the paper backing of the transfer is soaked with water, so that it may be peeled off, and the transfer is once more rolled down with a wet felt roller. Between the transfer and the paper backing there is a layer of starch, which is softened by the water to facilitate removing the paper. The transfer is finally tapped with a dry piece of chamois leather. Varnish is able to resist the action of an etching acid, and as the varnish is likely to spread out from under the transfer to surrounding surfaces of the metal, it must be removed before the etching process is started. This can best be done with benzine or some other non-greasing deturgent with which the varnish is washed off the metal surfaces. One good way of accomplishing this result is to dampen the whole surface where the transfer has been applied with diluted turpentine or ammonia and then rub the surface lightly with a dry soft rag. This removes any varnish that has run out from under the transfer onto the surface of the metal which must be exposed for etching. Where extremely fine etching is required, it may be a good plan to apply one or two coats of varnish over the transfer and allow it to stand for a day before proceeding with the etching.

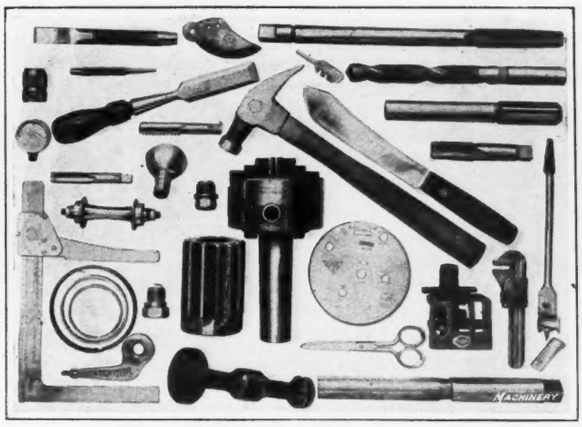


Fig. 9. Examples of Work with Trademarks impressed with Dwight Slate Marking Machines

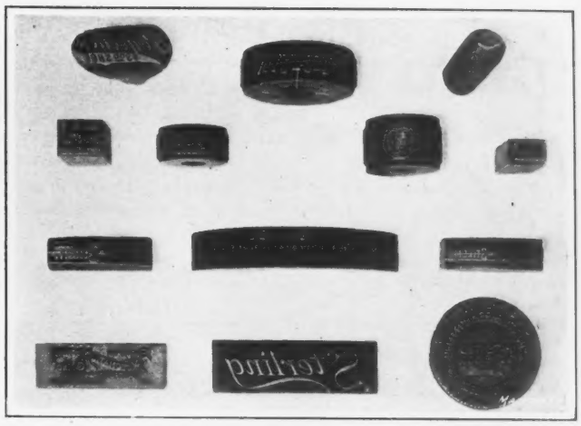


Fig. 10. Examples of Dies made for Use on Dwight Slate Marking Machines

After the preparation of the work for etching has progressed to this point, the following steps in the process will vary according to the depth to which it is required to etch the trademark. If a deep marking is required, it will be found necessary to paint over the decalcomania transfer with asphaltum varnish, and also all exposed surfaces of the metal, except where the etching is to be done. Then after this varnish has had time to dry, the work can be immersed in an etching bath for the required length of time to produce a marking of the desired depth. When it is only required to etch lightly, a small amount of acid can be placed over the design, and if the surface is flat and level, there will be no danger of the acid running, and so it is unnecessary to apply asphaltum paint around the edge of the transfer. After the resist has been prepared in this way, the etching process is accomplished by the use of acid or any other suitable fluid in exactly the same way as if the resist had been prepared by the application of wax or some other material which would not be affected by the etching fluid. When applying transfers, it is important to have the work thoroughly cleaned to remove all traces of grease from the metal. In the factory of Henry Disston & Sons, Inc., Philadelphia, Pa., this method is used for applying trademarks to various types of saws. About sixty saws are laid out along a bench and, after the transfers have been put on, the etching acid is applied with a small sponge. The workman walks all down the line, moistening the sponge with acid and applying it to each saw blade. Then he starts again at the top of the line and rinses off the acid with a large sponge soaked with water. This means that the acid is left on the work for about five minutes.

Impressing a Trademark into a Metal Surface

Another commonly used method of trademarking is to employ a stamp to impress a trademark into the surface of a metal product. In some cases, a single stamp can be made to include all of the marking that is required, while in other cases individual stamps are made, each of which has one letter or figure, so that these stamps may be used successively to produce the required marking. Where the latter method is employed, trouble is likely to be experienced through irregularity in the depth of impressions secured with different stamps. A little thought will suffice to show that for figures of a given height it will require more pressure to sink a figure 3 to a specified depth in the work than to sink a figure 1 to the same depth. Some plants have conducted very careful investigations of the relative amounts of pressure which are required and have arranged each stamp with a weight that slides on a bar attached to the top of the stamp. Each of these bars is arranged with a limit stop, so that the height from which the weight falls onto the stamp to provide for impressing the stamp into the work may be varied according to conditions. By determining the relative height from which each weight should fall in order to impress the letter or figure to the desired uniform depth, provision is made for producing a trademark of satisfactory appearance.

Such a method of providing for the production of uniform marking in the work is obviously a tedious process and one which involves considerable loss of time. A much more satisfactory method is to use one of the Dwight Slate marking machines built by the Noble & Westbrook Mfg. Co., of Hartford, Conn. These machines are furnished with a die on which the desired marking is left in relief by cutting away the surrounding metal. The machine is operated by having the die carried on a slide so that this die may be moved over the surface of the work in which it is desired to impress the trademark. The work is carried on a table supported by a vertical slide, and this table is raised to bring the work into contact with the die by pushing down a foot-lever.

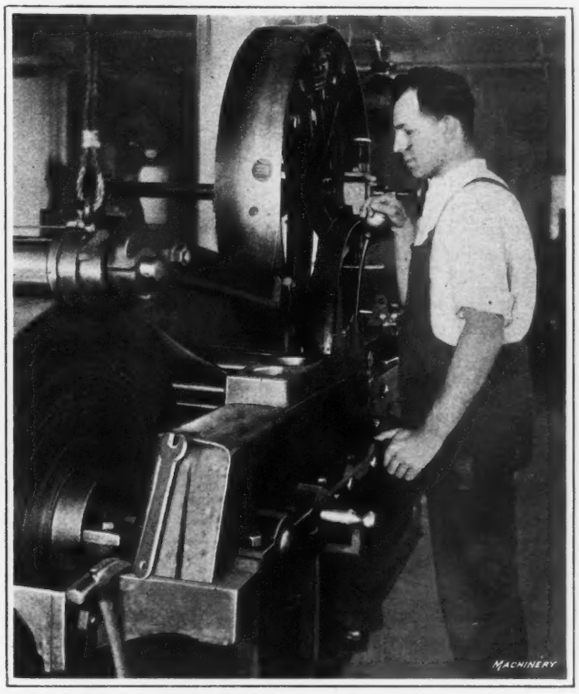


Fig. 11. Combination Trademarking and Measuring Machine used for impressing "Duxbak" Trademark into Schieren Leather Belting

An adjustable stop is set so that the foot-lever brings the table to a uniform position each time, in order that the marking may be of the same depth in all pieces of work, and the operation of the machine itself insures a uniform depth of marking on each individual piece. Either flat or cylindrical shaped pieces may be marked on the machine. In the case of cylindrical work, a flat die is used and the work is rolled on the table under this die. Where it is desired to mark flat work, a cylindrical shaped marking die is used which is rolled over the surface of the work. In addition, provision may be made for marking on tapered pieces of work, special fixtures being provided for handling such operations. Figs. 8 and 12 show machines set up for marking flat and cylin-

drical shaped work, respectively. A good idea of the range of trademarking which may be handled on the Dwight Slate marking machine will be apparent by referring to Fig. 9, which shows a number of examples of work; and in Fig. 10 there are shown different types of marking dies made for use on the machine. In using a round die for marking flat work or a flat die for marking round work, it will be apparent that there is only one point of contact between the die and the work at any one time. This greatly reduces the amount of pressure required to impress a given marking, and as a result many kinds of material that would otherwise be distorted can be readily marked by this process. For instance, it is found

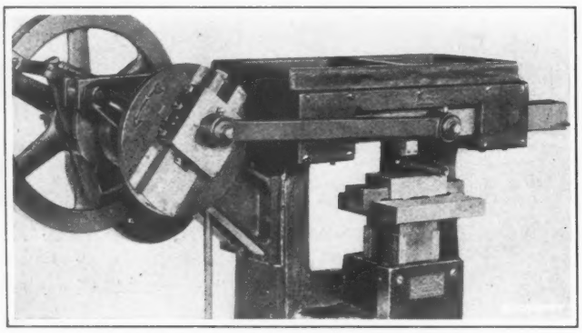


Fig. 12. Dwight Slate Marking Machine equipped for impressing Trademark in Cylindrical Work

practicable to impress markings into hollow tubes. Adjustments are provided on the machine for use in connection with flat or round dies, so that the proper character on the die comes into contact with the work at a specified point, this adjustment being obtained by screw stops. Movement of the slide which carries the die across the work is effected by a hand-lever which actuates the slide by means of a rack and pinion.

A somewhat similar method is employed by manufacturers of leather belting for impressing a trademark into the surface of this product, but in the case of belting care must be taken to make the marking die with the edges of the raised design carefully rounded, instead of having these edges sharp. The reason for taking this precaution is that in making belting it is the practice to impress the trademark into the belting by compressing the leather under the raised portion of the die without actually cutting the fibers of the leather. If these fibers were cut, it would naturally result in weakening the belting. In Fig. 11 there is shown a combination trademarking and measuring machine used in the plant of Charles A. Schieren Co., 73 Ferry St., New York City. It will be seen that this machine is equipped with a wheel and that the belting to be marked runs under it so that the stamp may impress the Schieren trademark of "Duxbak Belting" together with the registered design in the surface of the leather at each interval of ten feet. This machine also stamps the length of belting, which greatly facilitates the work of measuring up any specified length of belt that is required for a given drive. The trademarking machine is equipped with a mechanism which automatically adjusts the marking punches to bring up the required tens digit in 10, 20, 30, etc., while the units digits are placed around the circumference of the wheel so that they mark from 1 to 10 in each successive interval of ten feet of belting. On this machine, belting up to 14 inches in width may be marked, and for marking larger widths of belting a hand stamp and hammer are employed, as shown in Fig. 13.

Method of Marking Steel Barrels and Boxes

Barrels and boxes made of sheet steel are naturally more expensive than similar wooden containers, but when made of steel they can be used repeatedly, so that the price paid for service rendered by steel barrels is often less than when they are made of wood. Wooden barrels are quite commonly marked by either pasting a label on the barrel or painting the desired marking on it, but either of these methods produces a mark which is likely to be obliterated. With expensive steel barrels which are to be used repeatedly, the owner does not like to run the risk of losing his property, and so it is highly desirable to adopt some more permanent form of marking than that produced by pasting on a label or painting the name on the surface of the steel. One excellent method, which is quite commonly used by manufacturers of steel barrels, is to employ sectional embossing dies of the form shown in Figs. 14, 15, and 16. The dies shown in these illustrations are made by James H. Matthews & Co., 3946 Forbes Field, Pittsburg, Pa. The particular advantage of these dies is that they may be assembled in any way to provide for producing the desired marking on the head of a barrel, and firms engaged in making barrels for a number of customers are able to rearrange these sectional dies for applying the desired marking to work that is being done for different customers, instead of having to go to the expense of having a special solid die made for each customer's work.

In marking the head of a barrel with these dies, provision is made for assembling the upper and lower die members into the faces of the dies used for drawing up the barrel head, so that the drawing and embossing operations may be performed at a single stroke of the press. Those who anticipate using dies of this kind to mark their work will naturally be interested in learning of the amount of pressure which is required for performing the embossing operation, and in answer to this question it may be stated that each one-inch letter requires a pressure of 10,000 pounds for embossing ten-gage steel. In Figs. 14 to 16, it will be seen that the equipment consists of an upper and a lower holder in which the upper and lower embossing die sections are assembled. The illustrations show holders made to accommodate three lines of letters and one line of figures, but holders are made to carry different combinations of letters and figures. The available standard holders have the following combinations: one line of letters, one line of letters and one line of figures, two lines of letters, two lines of letters and one line of figures, three lines of letters, three lines of letters and one line of figures, four lines of letters, and four lines of letters and one line of figures.

An advantage arising from the use of these sectional dies is that they are always available for use, thus saving time which might otherwise be lost through the necessity of waiting for a solid die to be made. The use of these sectional dies,



Fig. 13. Form of Hand Stamp used for impressing "Duxbak" Trademark on Wide Leather Belting

which constitute a standard feature of equipment in a plant engaged in the manufacture of work which can be marked by such dies, saves the expense of making a special die, and thus often enables one manufacturer to underbid his competitor whose figure is based upon the necessity of making a solid die for marking the work. Experience in the performance of embossing operations with dies of this type has shown that certain combinations of letters of the alphabet will provide a sufficient supply to enable the user to set up practically any name and address or other marking which his customer desires



Figs. 14, 15, and 16. Sectional Embossing Dies made by James H. Matthews & Co. which can be assembled in Holder like Type to provide for embossing Required Marking on Heads of Steel Barrels and Other Sheet-metal Products

to have placed on the head of a steel barrel. This is a modification of the printer's font system, and for a barrel head embossing outfit, what is known as a "Five A" font of dies is usually supplied, which consists of the following sets of letters: Five A's, three B's, four C's, four D's, six E's, three F's, three G's, four H's, five I's, three J's, two K's, six L's, four M's, five N's, five O's, three P's, two Q's, five R's, six S's, five T's, four U's, three V's, three W's, two X's, three Y's, two Z's, two &'s, and two periods. In each case the figures given refer to a set of dies, and each set comprises one male and one female letter, with sufficient clearance between them to accommodate the metal which is being embossed. The dies are made of a suitable grade of carbon tool steel, which gives them a high degree of durability.

Whenever a line of the figure or letter holder is not employed to its full capacity, it is necessary to fill up the remaining spaces with blanks or "spaces," as they are commonly called. These spaces can be correctly set up with the letters in any line, the following being a case in point: Suppose the number of letters in the holder is quite small. It is necessary to place blanks evenly on each side of the letters in order to produce a neat looking arrangement. Spaces are also necessary, because it is imperative for the holder to be completely filled with either letters or spaces while the embossing operation is being performed. For any set of holders from two lines up, the following spaces are needed: Eight sets of 2-inch spaces, eight sets of 1-inch spaces, ten sets of $\frac{5}{8}$-inch spaces, four sets of $\frac{1}{4}$-inch spaces, and six sets of $\frac{1}{8}$-inch spaces. To provide for holding figures, letters, and spaces when not in use, James H. Matthews & Co. make a special cabinet equipped with a hinged lid. The use of such a cabinet not only protects the die sections from damage, but also provides a definite place for them, so that the danger of loss is greatly reduced.

The term "fool-proof" is applied to these embossing die sections because it is impossible to assemble them in the holders in any other than the correct position. It will be apparent that considerable damage could easily be done if one or more die sections were placed in the holder upside down. The upper holder for the sectional lettering and figuring dies is made of tool steel, and the lines for the letters work on a slide, as clearly shown in Fig. 15, thus making it unnecessary to remove the upper holder from the head of the press in order to change any of the die sections. The lower holder is fastened to the bedplate of the press, and this holder carries the male dies. The die sections for embossing figures are furnished with wire handles, as shown in Figs. 14 to 16, and the die-holders are placed on the press with these handles facing



Fig. 17. Method of applying Decalcomania Transfer Trademark to Gasoline Pumps built by S. F. Bowser & Co.



Fig. 18. Stripping Paper Backing off Transfer after Paper has been loosened with Water

toward the front. Both the upper and lower holders for figures are equipped with spring pin locks which engage the die sections when they are pushed into place in the holder. When it is desired to change a die section in the holder, a slight pull on the wire handle pushes this pin lock down into the holder so that the die section can be withdrawn.

Attention has already been called to the slide arrangement for holding the lettering die sections. The upper die sections have to be assembled in the holder face down, and to facilitate the work of assembling these sections, without danger of mounting them in the wrong position, a practice is made of marking the letter on the back of the die-block to correspond with the letter which is actually cut in the front of the block. The slides in which letter sections are mounted are provided with means of securely locking them in position when the die has been completely assembled ready to start performing the embossing operations. In conclusion, attention is called to the fact that this equipment can be used for embossing names, numbers, etc., on curved surfaces. There are, however, many limitations in the application of these sectional embossing dies on anything but flat work. This is due to the fact that when curved holders and curved dies are made, each section of the holder and each die section is curved to a different radius, as a result of which considerable time is required to properly assemble the dies ready for use.

Decalcomania Transfer Method of Trademarking

Where the frames of typewriters, gasoline pumps, and a great variety of similar metal products are to be painted and then given a final finish by applying lacquer or varnish to the painted surface, a very effective method of trademarking is to make use of the decalcomania transfer. These transfers are made in any desired form and in practically any color, and they may be very easily applied to the work after the painting has been done, but before the final coat of lacquer or varnish has been applied. The varnish covers the transfer, and not only gives it a good appearance, but also protects it from becoming discolored or worn off. The transfer consists of a design lithographed on aluminum foil. This material would be very easily torn, and so to afford it the desired protection, the lithographed foil is mounted on a sheet of paper for shipment to the customer. In applying the trademark, the surface on which the marking is to be applied is first given a coat of varnish, which is allowed to stand until it becomes decidedly "tacky." The transfer is then applied to this varnished surface and rolled down so that the aluminum foil is held by the varnish at all points, after which sufficient time is allowed for the varnish to dry completely. When this result has been obtained, a wet sponge is applied to the paper on which the aluminum foil is mounted, and after the paper has been thoroughly soaked with water in this way, it can be readily stripped off, leaving the transfer exposed ready to be given a final coat of lacquer or varnish. To facilitate the stripping off of the paper, a layer of starch is placed between the paper and the aluminum foil which is mounted on it, so that when water is applied with the sponge this starch is dissolved and causes the paper to be loosened from the foil so that it can be readily removed. It is not only a very easy matter to apply a trademark by this method, but the result is of good appearance, and quite durable after it has been protected by one or more coats of lacquer or varnish. Figs. 17 and 18 show steps in the process of applying decalcomania trademarks to automatic gasoline pumps built by S. F. Bowser & Co., of Fort Wayne, Ind.

Branding Trademark with a Hot Iron

An effective method of trademarking the wooden handles of files, chisels, and similar tools is to burn the trademark into the wood with a hot iron. To facilitate handling this work, the Simmonds Hardware Co., of St. Louis, Mo., has electrically heated stamps made with the desired trademarking. These stamps are placed on a table with the surface of the stamp at a sufficient height above the table, so that when the work is rolled over the hot stamp, the trademark is burned into the wood to the required depth. By this method, trademarking may be done very rapidly, because the practice is to roll the wooden tool handles across the surface of the hot stamp or "branding iron" as it might be more properly called, and when a workman knows how to perform this operation efficiently, almost a continuous stream of tools can be kept going across the trademarking table. In order to make this possible, it is, of course, necessary to have helpers who bring the tools to the man who applies the trademark, and other laborers who carry away the trademarked tools. This is, of course, an economy, because very cheap labor can be employed for this transfer work, leaving the experienced mechanic free to devote all of his time to work where his experience makes him especially valuable.

* * *

WAGES AND THE WAR

BY F. R. DANIELS

One argument advanced by certain manufacturing concerns not engaged in war work against paying increased wages is that by doing so they would be deliberately competing with the Government in its effort to secure help, thus tending to hamper war work and the production of the necessities of war. In the case of the small manufacturers, no such argument is made, as it is quite evident that the lack of help caused by the steady exodus of machinists and tradesmen in general seriously affects their production, and the replacing of these men necessitates the paying of higher wages; often, even then, only inexperienced men can be secured. The output may be of such a nature that the demand for these products will not warrant the payment of increased wages, and under the existing conditions, such a shop, though small, but well organized, may become idle and the business ruined.

War conditions have made it necessary for the Government to enlist the services of a vast force of industrial workers, particularly mechanics, yet the fact that so many shops have, as a result, been greatly depleted, seems rather unjust to the manufacturer of non-war products, and especially to the small manufacturer. This state of affairs may be justified by some who take the attitude that this should be the contribution of such employers as a token of their patriotism, and that they should not hesitate to sacrifice their own financial welfare. If such a stand is just, then it would seem unfair that the manufacturer who is prospering at the expense of the small manufacturers should receive all the profits. Something should be done, it seems, to relieve the existing conditions in this respect. The selective draft is proving a success, and is the only impartial and practical plan for securing a great army of fighters. Would not a selective conscription of labor be a fair and expedient manner of alleviating the present strain and of maintaining an efficient industrial army? Under such a scheme, all war contracts should stipulate the payment of standardized wages, based on experience, education, or efficiency tests, for each of the various classes of work required. Maximum and minimum wages should be fixed which would not be out of proportion to the recognized standards for the particular kind of work to be performed. Every employer should be required to furnish the Government, at stated times, a list of names of men of suitable ability, age, and domestic responsibilities, who would be valuable to the Government and not indispensable to the organization of the various shops. If these lists were based on the percentage of men employed, all would be equally affected and probably none would be disorganized. The Department of Labor could classify these names and hold them in reserve, subject to distribution throughout the various government shops and other manufacturing plants engaged in war work.

Wherever possible, men conscripted in this manner should be merely lent to the Government, and their former positions held open until such time as their services would no longer be required by the demands of the war. Under this plan, the shifting of labor from civil pursuits to war work could be accomplished with fairness to the employer and the employe. Also, the small manufacturer and the manufacturers of non-war products would be properly safeguarded, and every business prevented from stagnation and possible ruin. On the whole, it seems that this plan is about as feasible as any of the many proposals made.

SPECIAL SHELL DRILLING MACHINES

BY DONALD A. BAKER[1]

As shown at *A*, Fig. 1, the fuse socket of the U. S. three-inch shrapnel shell has a small hole drilled through it at an angle. This hole is later tapped to take a set-screw. By means of the jig shown in Fig. 2, this drilling is done on a double-spindle drilling machine, so that two sockets are drilled at one time. The fixture consists of a cast-iron body *A*, to the two angular faces of which are screwed the locating nose-pieces *B* on which the work is placed. The plate *D* that carries the drill bushings *C* is supported by a stud *E* and is held in position by two pins *F;* these are a drive fit in the plate *D* and a sliding fit in the body *A*. The plate *D* is held under tension by a coil spring *G* that acts on the head of stud *E*.

The operation of the jig is as follows: The operator presses the treadle *H*, operating a lever *J*, which, acting through the stud *E*, raises the bushing plate *D;* this allows two fuse sockets to be placed on the locating nose-pieces *B*. When the foot is removed from the treadle, the bushing plate *D* is carried

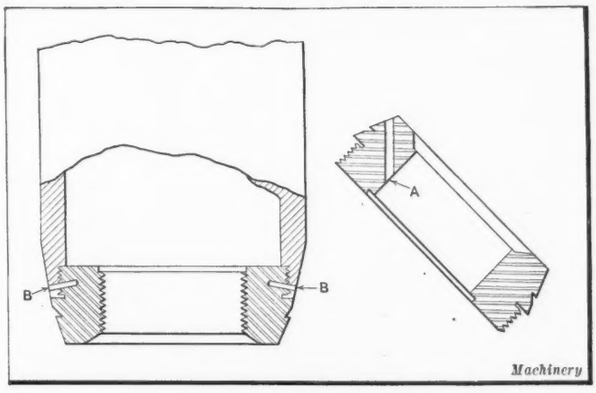


Fig. 1. Fuse Socket of Shrapnel Shell

down onto the work by the action of the spring *G*, which holds the work securely while it is being drilled. Drilling is done in the usual way, except that the pinions operating the sleeves that carry the drill spindles are connected to each other so that both are operated by a common hand-lever.

Dowel-pin Hole Drill Jig

At first, the dowel-pin holes *B*, Fig. 1, through the shell and fuse socket were drilled one at a time by using the fixture shown in Fig. 4. But when both holes are drilled simultaneously, by means of the machine shown in Fig. 3, the work

[1]Address: Care of Service Engineering Co., 25 Church St., New York City.

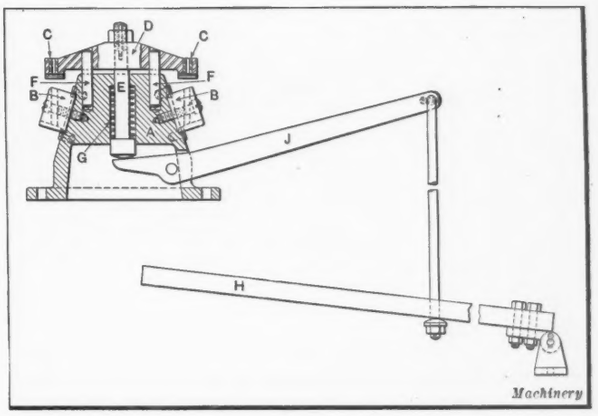


Fig. 2. Jig for drilling Fuse Sockets on Two-spindle Drilling Machine

is done more than three times as fast. This double-spindle drilling machine consists of two ordinary drill spindles *A;* only the left-hand one is shown, as they are identical with the exception mentioned later. These spindles were borrowed from existing equipment. The spindles are placed in suitable bearings *B*, which, in turn, are bolted to the frame of the machine; the latter is of angle-plate construction, as shown at *C*. The shell is located in the proper position by means of a locating plug *D*, made to fit the inner threaded portion of the fuse socket, which is held to close dimensions. This locating plug is carried by the angle-plate *E*, which is fastened to the frame of the machine as shown. The butt end of the shell is held in the proper position by means of a V-groove in the top of the bracket *F*, while the clamping is accomplished by means of the over-arm *G*, which is held under tension by the coil spring *H* and is operated by a foot-treadle, as shown. The feeding of the drills is controlled through an arrangement of the pinion *I* and the two bevel gears *J*, which are operated through the shaft *K* and the hand-lever *L*.

One of the unique features of the machine is the means of adjusting the drills to the work, irrespective of their length or the distance they project from their chucks, for to be used at their maximum efficiency it is necessary for both to start cutting at the same time. This is accomplished by arranging one of the bevel gears attached to the pinion shafts so that it can be either run free or locked fast on its shaft, as desired. This was done by boring a hole lengthwise through the center of the pinion shaft and then boring a taper in the end to which the gear was to be attached; this end was then split like an expansion mandrel type of chuck, and the taper drawbolt *M* inserted and fastened by a knurled-head nut *N*.

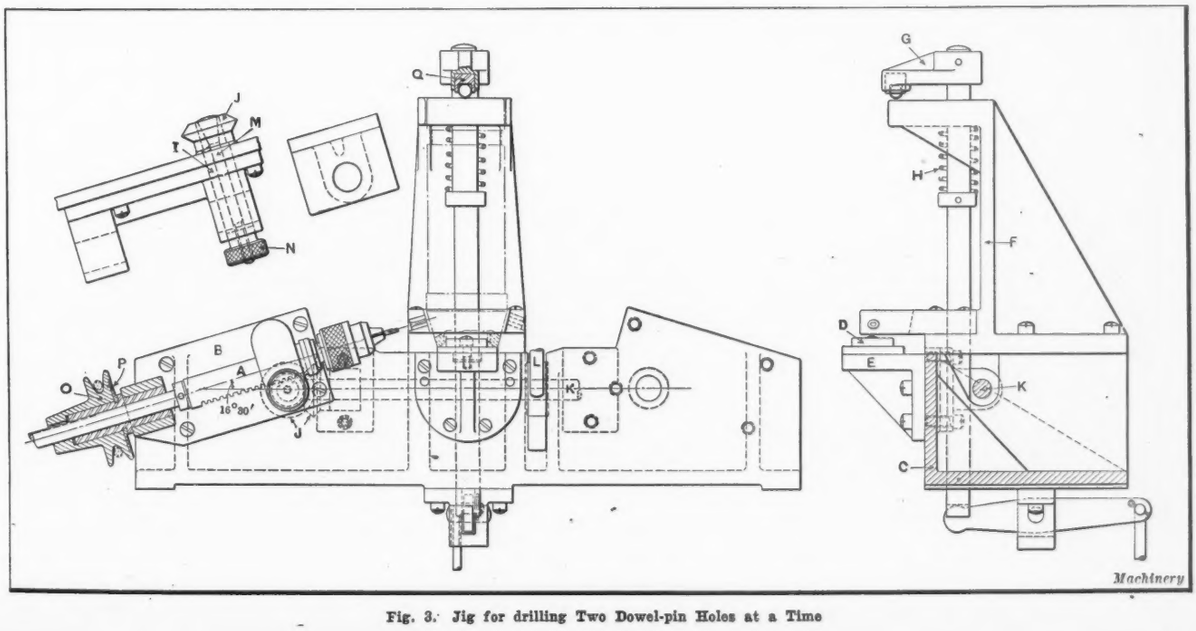


Fig. 3. Jig for drilling Two Dowel-pin Holes at a Time

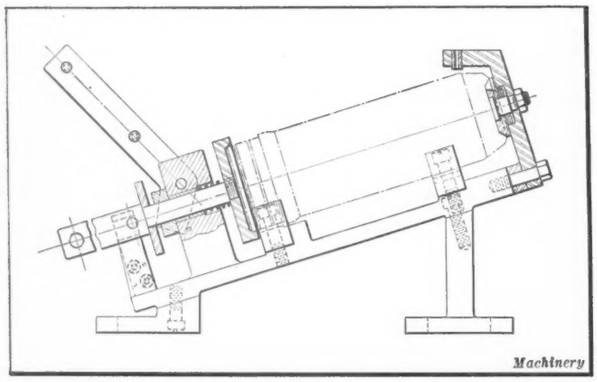


Fig. 4. Jig for drilling Dowel-pin Holes One at a Time

To set up the machine, the shorter drill is placed in the left-hand chuck and the hand-lever *L* is depressed until the right-hand drill is brought up against a set block, which is placed over the locating plug *D* and determines the depth to which the work is to be drilled, as these holes do not go quite through the work. In this position the stop-collar on the right-hand spindle is tightened; then the bevel gear *J* is loosened, and the left-hand spindle is brought forward by hand until its drill is against the set block. The gear is then locked by means of the draw-bolt *M* and the knurled nut *N*, and the machine is ready to produce. Only one stop-collar for controlling the depth of the drilling is needed, as one spindle is controlled by the other.

The driving is done by means of round leather belts over the grooved pulley *O*. On the upright machine from which these spindles were taken the pulleys retained their position by their own weight, but here they must be fastened in place. This is done by means of the thin split collars *P*, the two halves of which are held to the pulleys by means of small flat-head screws; the split collar runs in a groove cut in the bearing bushing.

The over-arm which holds the shell in place has a hardened steel ball, which is retained by a hardened cup *Q*, the outer end of which was drawn sufficiently so that it could be swaged in around the ball enough to keep it from dropping out, but not enough to prevent its turning freely. As its point of contact with the base of the shell is placed some distance back of the center line, if a careless operator does not place the shell in the proper position, the forces operating upon it when the foot-lever is released will automatically bring the shell into its correct position, seat it firmly on the locating plug, and back against the V-groove at the top. Running at a speed of 1500 revolutions per minute, this machine has a capacity of between 120 and 150 shells an hour.

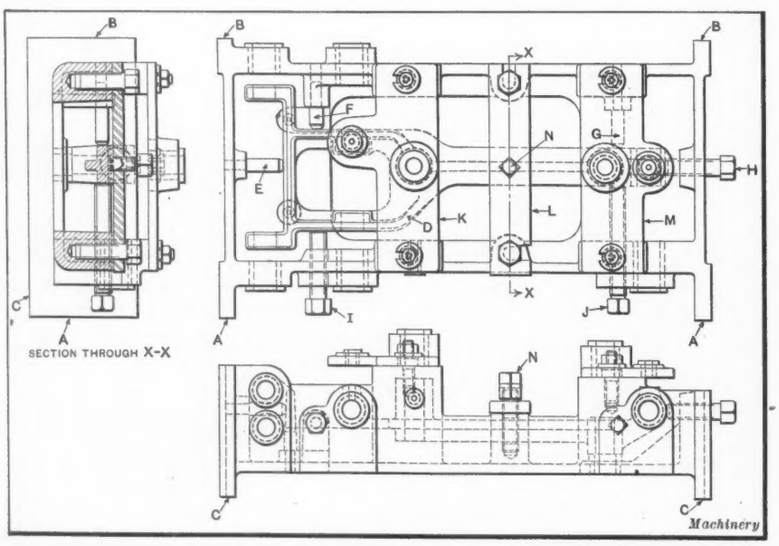


Fig. 2. Three Views of Box Jig, showing Arrangement of Bushings and Method of holding Work

USE OF BOX JIGS

Where there are a number of holes to be drilled in different sides of a piece of work, a great deal of time would be lost if separate jigs and work-holding fixtures were provided for drilling each hole, or even for drilling the holes in each different face of the work. It is well known by experienced drilling machine operators that the setting-up time is often considerably in excess of the actual drilling time, and so the loss resulting from the necessity of changing the work several

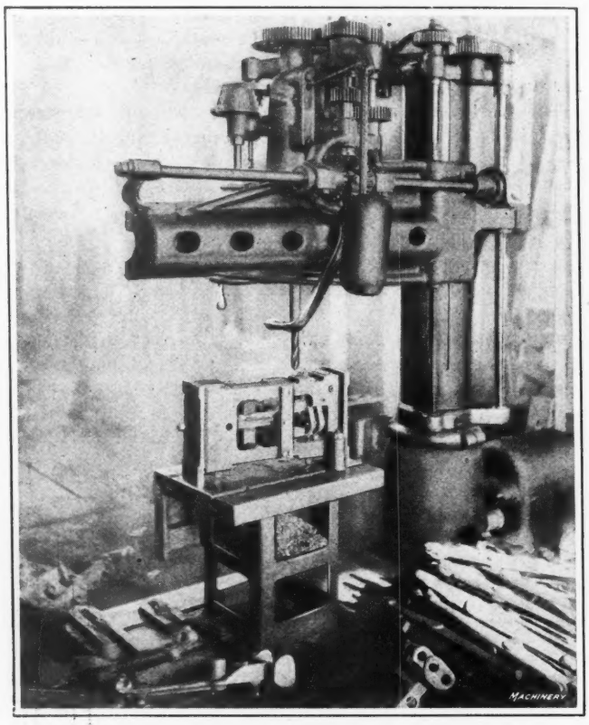


Fig. 1. Box Jig designed for drilling Holes in Shifter Bracket

times in order to employ different jigs and fixtures for various operations would be a very serious matter.

To overcome the difficulty, it is common practice to use what are known as box jigs, in which the piece to be drilled is supported; these jigs are furnished with feet on different sides, which provide for supporting the work with the different surfaces in which holes must be drilled held ready for the performance of such drilling operations. In this way, the work is set up once and the box jig may be turned over to bring different sides of the work into the drilling position, enabling all holes to be drilled without loss of time in resetting. In Fig. 1 is shown a radial drilling machine engaged in drilling the holes in the shifter bracket for one of the No. 216 drilling machines built by Baker Bros., of Toledo, Ohio. With this box jig, provision is made for drilling holes in three sides of the work through the finished faces *A*, *B*, and *C*, Fig. 2, on the jig.

The way in which the work is located in this jig is as follows: Work *D* is dropped into the jig and pushed up into contact with three locating stops *E*, *F*, and *G*, after which bolts *H*, *I*, and *J* are tightened to hold the work in contact with locating stops *E*, *F*, and *G*, respectively. After this has been done, straps *K*, *L*, and *M* are placed over the work and secured by bolts, the provision of C-washers enabling these straps to be put in place or removed quite rapidly. Straps *K* and *M* both carry guide bushings, and bolt *N* in strap *L* holds the work down in the jig. The use of box jigs for work of this kind will be found to increase production rates considerably.

E. K. H.

LETTERS ON PRACTICAL SUBJECTS

WE PAY ONLY FOR ARTICLES PUBLISHED EXCLUSIVELY IN MACHINERY

AN ECONOMICAL METHOD OF PRODUCING MECHANICAL DRAWINGS

The effort that is being made at the present time to increase the production of mechanical drawings brings up the important question as to what type of drawing is best adapted to the requirements of both purchaser and manufacturer. Drawings that are used by workmen in the shop necessarily contain many notes and dimensions that are of no use to the purchaser and they are too complicated and confusing for the purchaser's needs. On the other hand, a drawing that is suited to the purchaser's needs does not necessarily contain the dimensions and notes necessary in producing the machine. Thus it will be seen that to meet the demands of both purchaser and manufacturer it is necessary in most cases to produce two different sets of drawings. In making pencil drawings and tracings, such as are in general use, a great deal of unnecessary detail is likely to creep into their makeup, which naturally delays production. The scarcity of draftsmen has also made it difficult to obtain the required drawings in many cases.

As the drawings required by both manufacturer and purchaser usually differ only in the dimensions and notes they contain, it seems a useless waste of time to make two sets of drawings that are so nearly alike. But this practice is necessary when using ordinary pencil drawings and ink tracings. However, there is a method of making mechanical drawings that eliminates the necessity of making two sets of drawings to meet the requirements of both purchaser and manufacturer. This method, known as the "Van Dyke" method of producing mechanical drawings, has not received

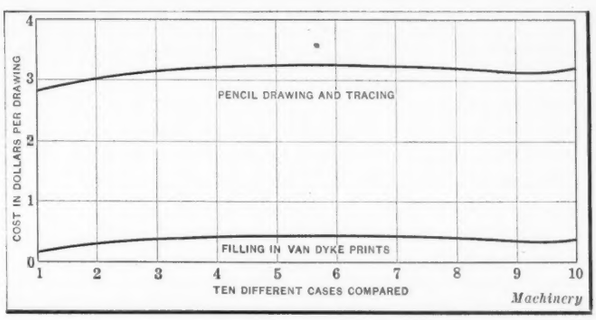


Fig. 1. Comparative Costs in making Mechanical Drawings

much attention in the technical publications, but it is being used with great success by some of our largest manufacturing concerns, and the writer, who has used hundreds of these prints and who is familiar with the method of producing them, believes that many manufacturers will realize a great saving in time and expense by using this system of producing mechanical drawings.

The Van Dyke method may be described as follows: A regular detail tracing of each machine is prepared, fully dimensioned, and properly filled in with notes necessary to complete the machine. When these tracings are completed, each dimension and note is obliterated by blocking out all dimensions and notes with ink. The tracings then become what are termed "master drawings." In blocking out, an outline is first drawn around each dimension and note with a ruling pen. These enclosed spaces are then filled in with a lead pencil which fills the pores of the cloth, after which the spaces are filled in with ink. The pencil lead prevents the ink from penetrating the cloth and causing wrinkles where large spaces are blocked out. Van Dyke prints are then made in the usual way from the master drawings. A supply of these prints should be kept on hand so that they may be filled out at short notice. Tables are prepared which contain

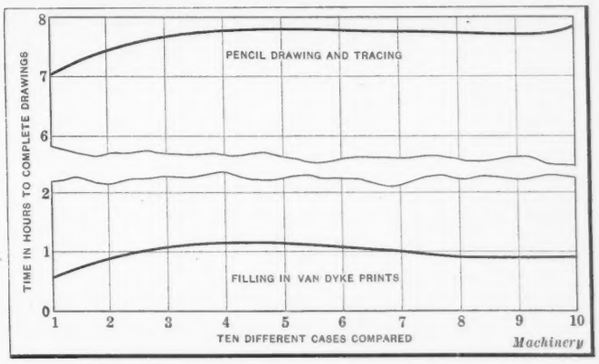


Fig. 2. Comparative Time required to complete Drawings

the dimensions required in the shop when building each standard machine and also dimensions that are necessary in the drafting-room.

When a print is needed in the shop, the drafting-room, or by a purchaser, the dimensions required are filled in from these tables and all unnecessary dimensions and notes are omitted. In this way a drawing that is free from unnecessary detail is quickly and easily prepared. In Fig. 1 is shown the comparative cost of pencil drawings and Van Dyke prints. These data were obtained from records of tests covering a period of two years, which were made by a well-known manufacturing concern. Fig. 2 shows the relative time required in making the two types of drawings.

The ink tracing or "master drawing" should be kept in indexed files in the drafting-room, but the Van Dyke print with its paper of bond-like quality, tends to tear when filed in an ordinary filing cabinet. Therefore some other method of filing should be adopted. One company that uses these drawings in contract work makes a practice of folding them after use and placing them with the contract data. This method proved very satisfactory, as the contract file was located in the drafting-room.

Buffalo, N. Y. LAWRENCE H. GEORGER

AIR-RIFLE LOCK-KNOB HOLDER

The accompanying illustrations show a lock-knob holder of an air rifle and the dies for making it. In Fig. 1, *A* shows the finished piece, which is made in two operations, and *B* the piece after the first operation. Fig. 2 shows the die for the first operation. This pierces three holes and rounds the end of the blank in the first stage, and cuts it off and gives it the form shown at *B*, Fig. 1, in the second stage. The finished piece is pushed out of the die by the spring pad *A*, Fig. 2, and is carried by the forming punch *B* to the top of the stroke, where it is pushed off by the pin *C*. As the press is inclined, the piece drops into a box at the back of the die. Fig. 3 shows the die for the second and last operation. This die finishes the form and drifts the hole in the top ready for it to be tapped. The forming die *A* is carried on a spring, and has

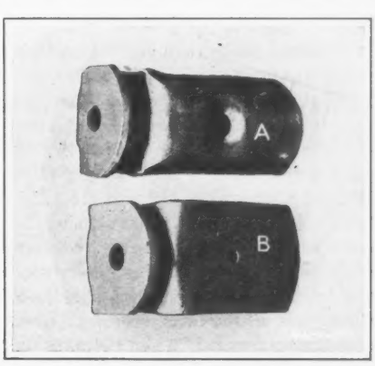


Fig. 1. Lock-knob Holder in partly made and Finished Form

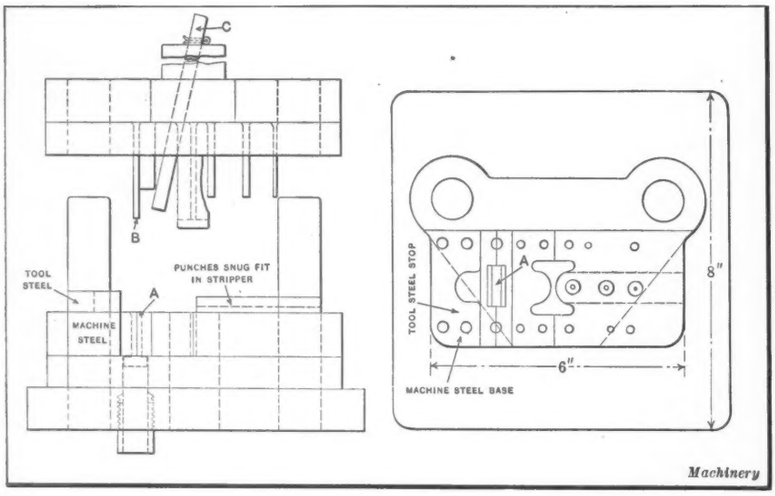


Fig. 2. Die for making First Form of Lock-knob Holder

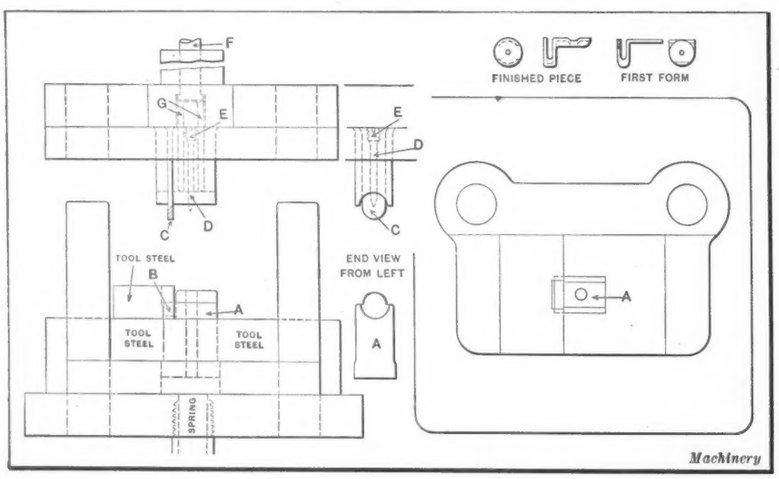


Fig. 3. Die for finishing Lock-knob Holder

enough travel for the piece to be placed in position with the double end loose in the upper part of a tapered pocket *B*. When the punch descends, this double end is carried down with the die and is formed into a circle between the forming die *A* and the upper part of the punch, while the blade *C* holds it to shape inside. At the same time the flat top is made half round to correspond with the end. The drift punch *D* is backed by a set-screw *E*, as the punch-holder is drilled out at this point for the knock-out *F*, which operates the two pins *G* that push off the finished piece at the top of the stroke.

De Kalb, Ill. W. B. GREENLEAF

OBTAINING RESULTS IN SPECIAL MACHINERY DESIGNING

What is meant by results? Evidently that a machine built from certain plans will have a satisfactory output and will give reasonable service without troubles of various kinds. It should also be without faults that will necessitate the expenditure of additional capital for experimenting to realize the results desired. To attain these ends requires cooperative procedure. The designer should profit not only from his own experience, but should utilize the experience of others. He should also have a systematic method of attacking his work and not allow any haphazard methods to prevail.

The first cost of a special machine is always high, so the chances of failure should be reduced to a minimum to avoid costs for experimenting, and also to avoid delays before getting the machine into successful operation. A designer, therefore, should get all the ideas on the problem obtainable before doing any drafting work. When he takes up the work of making the drawings he should have a clear conception of what is to be done. A good method of procedure is as follows:

First, obtain complete data as to the present methods of handling the work the special machine is to do and the costs, in order to determine how profitable an investment the special machine will be. This should be done before the project is carried too far.

Second, make a preliminary design for the contemplated machine to such a reduced scale as is considered necessary; this design should consist of only enough lines to convey the general idea of the machine. Feeds, speeds, and the output of work should be figured and a rough estimate of the cost of the machine should be made.

Third, submit this design, together with all data, to those who are concerned, for criticism or approval; the various ideas or changes suggested should be noted. The work should not be carried beyond the preliminary design stage until a general agreement has been reached as to what kind of machine will be required; the principles of construction should be right.

Fourth, make a final preliminary design from which it will be possible to develop the various units of which the machine will consist.

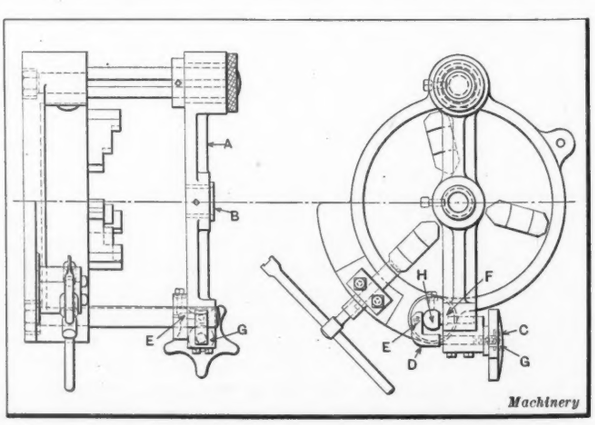
The designer may now employ others to aid him in developing and detailing the units. When a unit is completed, the blueprints may be sent to the machine shop and the work of building the machine carried along with the designing. A competent designer who has a job well in hand can carry out this idea to the extent that the machine he is designing may be well along in the shop by the time he is putting out his final drawings.

One great advantage of building a machine on the unit principle is that it is possible to note, when a unit is completed, if it will perform the functions required of it. A unit, the performance of which may be in doubt, may be built before the others, so that it will not be necessary to build a complete machine in order to experiment with an idea.

Newark, N. J. F. E. JOHNSON

UNIVERSAL DRILLING AND REAMING JIG

The accompanying illustration shows a drilling and reaming jig having two distinct advantages, namely, an adjustable drill-bushing holder to suit all heights of work, and a quick-action clamping device. In operation, the bridge casting *A*, which holds the drill bushing *B*, is moved into position, and the knob *C* turned to the right, causing the clamping bolt *D* to move with the knob until stopped by the pin *E*. The knob is then tightened in the usual manner, bringing the clamp



Jig for drilling and reaming Gears, Pulleys, Sprockets, etc.

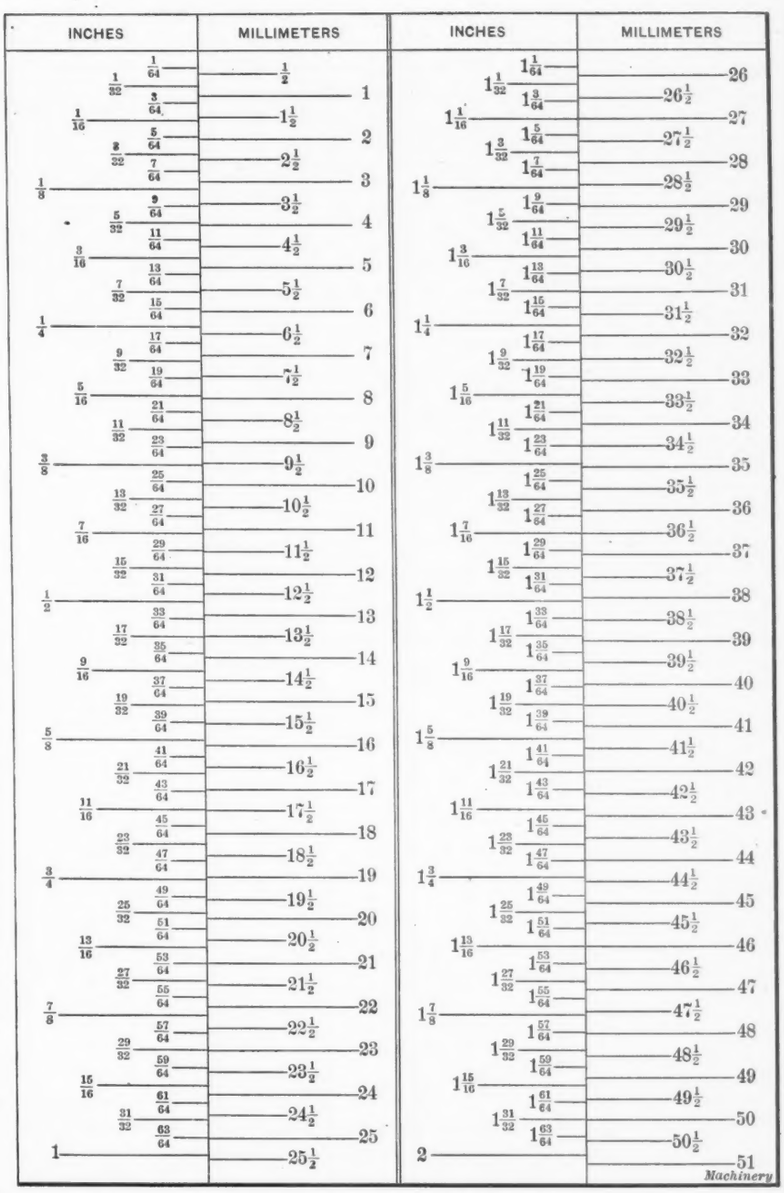
against the stud *H*, which bears against the hardened end of the pin *F*. To unclamp, the knob is turned to the left until stopped by the washer *G* on the threaded end of the clamping bolt which acts as a lock-nut, thus causing the bolt to turn sidewise with the knob so that the bridge casting may be moved to one side, allowing removal and substitution of the work. The bore of the bridge casting should be made to a standard size, so that bushings for different classes of work will be interchangeable. For holding the work, a universal lathe chuck is used, and by providing false jaws, such work as small pulleys, sprockets, gears, bushings, etc., may be machined with this type of jig. After the jig is once placed on the drilling machine, it is only necessary to change the bushing and jaws to adapt it for different classes of work.

Seneca Falls, N. Y. E. L. ROBENOLT

VALUES OF FRACTIONS OF INCH IN MILLIMETERS

With the increased use of the metric system in this country in the past few years, various methods have been devised for obtaining the equivalent values when either the English or the metric system is given. The accompanying chart will be found especially useful when only approximate results are desired, as it gives the relative value in millimeters of each sixty-fourth of an inch up to two inches. Thus it shows that 29/32 inch is equal to 23 millimeters; carried to three decimal places, the correct value would be 23.019 millimeters. It also shows that 13½ millimeters is equal to 17/32 inch; carried to three decimal places, the correct value of 17/32 inch is 13.493 millimeters.

Detroit, Mich. C. H. WHIPPLE

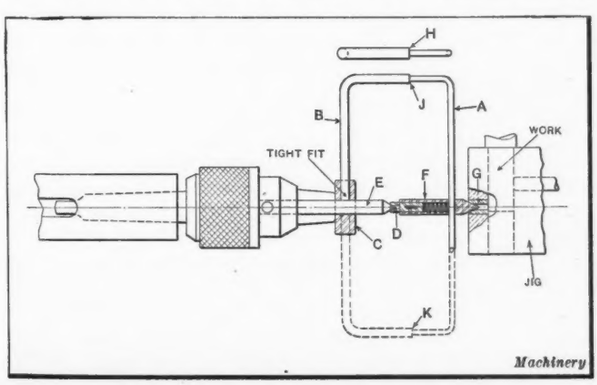


Relative Value of Fractions of an Inch in Millimeters

DEVICE FOR LINING UP SMALL DRILLS WITH DRILL BUSHINGS

It is often the practice, when setting up a drilling machine job for small holes, to spring the drill enough to enter the bushing, instead of bringing the bushing into alignment with the drill. This results in broken drills.

The writer finds by using the device shown in the illustration when setting up automatic drilling machines for drilling small holes, such as 0.093 inch diameter in 5/8-inch pins, that it is possible to save about 75 per cent of the drills which would have been broken if such precaution had not been taken. The collar *C* should turn on center *E* so that it will be possible to swing the rods *A* and *B* from position *J* to position *K*. Rod *B* should be a tight fit in collar *C*, and rod *A* should be free to turn in the center *F*. There should be just enough spring tension back of the plunger *D* to hold the centers in place. If the bushing *G* is in line with the drill spindle, the centers *E* and *F* will be in perfect alignment, and the rods *A* and *B* will be in contact at point *J* as shown, and also at point *K* when in the position shown by the dotted lines. To determine readily if contact is made at each position, rod *A* is turned in center *F* as shown at *H*. If rods *A* and *B* do not come in contact at both positions *J* and *K*, the jig should be adjusted until they do, thus bringing the drill and drill bushing into alignment.



Device for lining up Small Drills with Drill Bushings

South Manchester, Conn. ALFRED PILLING

PUTTING RUBBER ON BAND-SAW WHEELS

The rubber on band-saw wheels should be in the form of endless bands and of pure gum if long and satisfactory service is to be obtained. After the old bands are removed, the rims should be thoroughly cleaned, if of iron; if of wood, they should be turned true. Then both the band and the wheel should be given a coat of thick shellac and allowed to set for a half hour, after which they should be given another coat and the bands stretched on the wheel. Care must be taken not to have them stretch more at one point than at another, as that will leave thick and thin spots in the band. A good way to even the tension is to put a thin piece of wood between the band and the wheel, long enough so that each end may be

grasped and drawn around the wheel between the band and the wheel. After equalizing the tension of the band, the wheel should be allowed to stand for at least twenty-four hours. Even with the best of care, there will be high spots and the wheel will not be true. The writer has always found it possible to use a stick clamped to the frame of the machine for a rest on which a turning tool, ground to a point and very sharp, could be used to make the wheel perfectly true. It is then finished with sand or garnet paper. A perfectly true wheel reduces the breakage of saws to a minimum. Another common cause of saw breakage is too high tension; saws should not be so tight that they will vibrate to any tone.

Denver, Col. J. L. GARD

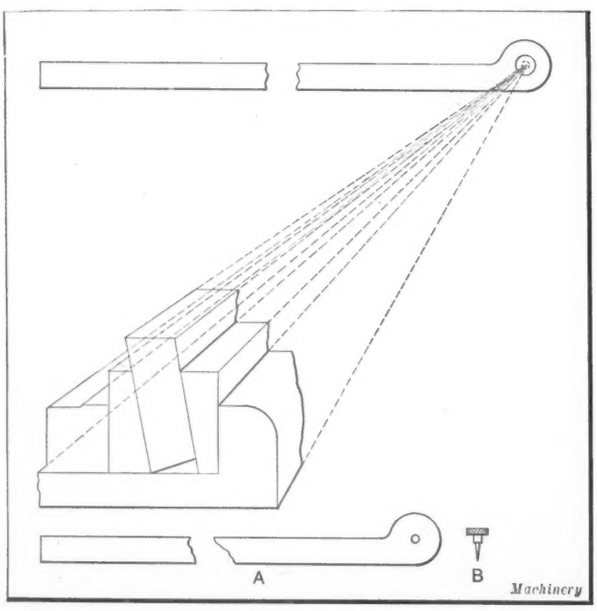
HORSEPOWER OF EXPLOSIVES

Many people seeing the powerful effects of explosives, have attempted to harness this power for driving automobiles, airplanes, etc., and numerous applications for patents on engines for this purpose have reached the Patent Office. If the inventors were better informed upon the subject, they would be saved danger, expense, and work; for there is much more power confined in a pound of gasoline than in a pound of dynamite. If they could see the half-dozen horsepower hours caged in a pound of gasoline expended in a fraction of a second, as is the case with the high explosive, they would waste no more time trying to tame a wild cat to do the work of a horse.

Jersey City, N. J. HARRY E. DEY

PROTRACTOR FOR MAKING LINEAR PERSPECTIVE DRAWINGS

In making drawings, it is sometimes necessary to represent objects as they appear to the eye at a given angle of vision. A good example of this type of drawing is shown in the accompanying illustration of a diemaker's parallels. In making drawings of this kind it is often necessary to draw a great many converging lines that terminate at what is known as



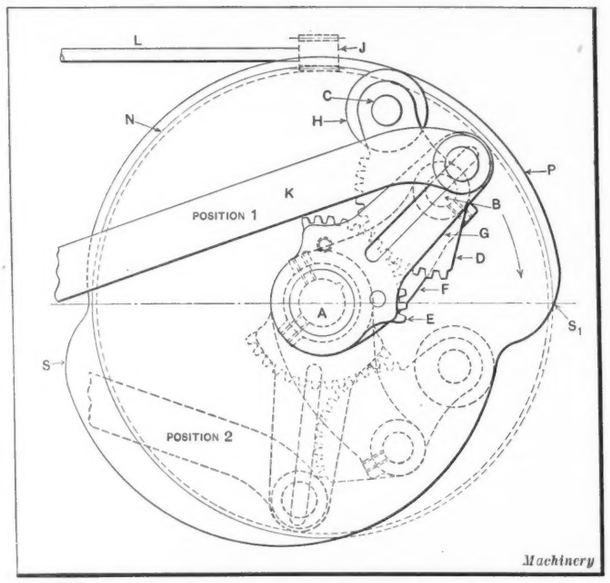
Method of using Protractor in making Drawing of Diemaker's Parallels

the "vanishing point." The protractor shown at *A* will be found convenient for drawing these lines in cases where the vanishing point may be placed inside the edge of the drawing-board. The protractor has a hole at one end to receive the special thumb-tack *B*. When it is decided what angle of vision is required, the thumb-tack is pressed into the drawing-board at the predetermined vanishing point. The converging lines can then be drawn along the top edge of the protractor.

New York City E. J. HIGGINS

TRAVERSE MOTION FOR GRINDER CARRIAGE

An interesting and unique mechanism for controlling the traverse motion of the carriage on a grinding machine is shown in the accompanying illustration. This mechanism is designed to feed the carriage by means of a crank motion. The accelerated motion given to the crank at the ends of the stroke is the principal feature of the device. This acceleration gives the carriage a uniform rate of travel the full length of the



Mechanism for obtaining Uniform Rate of Traverse of Grinder Carriage, with Crank Motion

stroke which prevents under-grinding at each end of the spindles. The illustration shows a plan view and two positions of the mechanism.

In Position 1, the parts are shown as they slide the carriage toward the end of the first traverse, while in Position 2 the return traverse has started. The driving rod, which is not shown, is connected to the connecting arm *K*, by an adjusting screw and nut. Worm-shaft *L*, which receives its motion from the main drive of the machine by means of bevel gears, carries worm *J*, which drives the upright shaft *A* through the worm-wheel *N* in the direction shown by the arrow. Driving arm *F*, is keyed and fastened by set-screws to *A*, as shown, and carries, at its outer end, a stud which is fastened by set-screws in hole *B*. Segment *D* has a forked or clevised end, in which the roll *H* is carried, revolving freely on stud *C*. The segment and roll are capable of pivoting on the stud at *B*. Segment *E* is loose on shaft *A*, and carries crank-arm *G* fastened to it by means of a screw and dowel-pin. The segment is prevented from lifting off by a head on the upper end of the shaft.

The grinding starts with roll *H* at point *S*, one full traverse being from *S* to S_1, where the return motion starts, ending automatically at *S*, after the necessary number of traverses has been completed. As the arm *F* swings around on *A*, segment *D*, which meshes with segment *E*, forces roll *H* against cam *P*.

When *H* reaches point S_1, and one traverse has been completed, the heel of cam *P* throws *H* toward the center, forcing the segment *E*, which is free to turn clockwise on *A*, to suddenly revolve about five teeth. This action throws arms *G* and *K* forward quickly, and incidentally the carriage as well, preventing a dwell at the end of the spindle. The resulting relation of the parts is shown in Position 2. Arm *G* has a T-slot, in which the connection of *K* may be adjusted, in or out, to obtain the desired throw, that is, the proper length of the traverse.

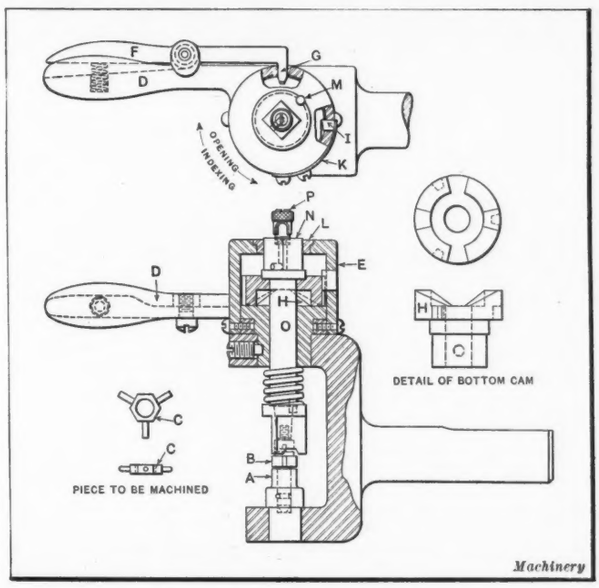
The feed of the carriage being constant, the same amount of time is consumed on either long or short traverses. Since the speed of *A* is always the same, as the length of the spindles increase, the number of traverses required is also

increased, by means of a knock-off device. It is obvious that the depth of the cut on short spindles is greater than that on long spindles, and that fewer traverses are required to grind short spindles to the desired size, and vice versa.

F. R. DANIELS

INDEXING FIXTURE FOR USE IN TURRET

The fixture here illustrated was designed by the writer to hold a small, hollow, hexagon spider while finishing the projecting spindles with a box-tool held in the spindle of the



Indexing Fixture for Use in Turret

lathe. The lower fork carries a projecting bushing *A*, which holds a swiveling member *B*, the upper end of which is turned to fit the hole in the center of the work *C*. The shoulder of member *B* is milled square to present as small a surface as possible for the lodgement of chips, which will throw the work out of center.

The end of the handle *D*, used for indexing and raising the spindle, is enlarged to form an inverted cup *E*, which acts as a dirtproof cap for the operating mechanism that it contains. This handle is furnished with a spring-loaded lever *F*, the end of which forms a taper pin *G*, which fits the indexing slots in the lower cam *H*. When handle *D* is turned in one direction with indexing pin *G* withdrawn, the catch *I*, held by the flat spring *K*, will slip out of the slot which it engages in the upper cam, allowing the spindle to be indexed to the next position. But if the handle is turned in the opposite direction, the catch will engage the straight side of one of the two slots, revolve the upper cam, and raise the spindle, thus permitting the work to be removed. In the top of cap *E* is a steel bushing *L*, held by a pin *M* that acts as a key, and through the center of the bushing is a square hole that fits a corresponding square *N* on the top of the spindle *O*. This bushing allows spindle *O* to slide up or down, but makes it turn positively with the handle. The oil-cup *P* and the hole through the spindle permit oil to be applied where lubrication is most needed. The enlarged lower end of the spindle is shaped to fit the work and is fastened to the spindle by a screw and key, as shown in the illustration to make it possible to assemble the fixture.

The fixture may be designed so that the flats on the upper and lower cams will engage when the spindle is raised, thus holding the spindle up and making it unnecessary for the operator to hold the handle, but probably this will not be necessary for most work, as the leverage and cam action will easily compress the large spring. The general principle shown may be adapted to similar tools for holding work to be drilled, faced, etc. This fixture may be used on a drilling machine table as well as on the turret lathe.

Dubuque, Iowa CHESTER W. HATHAWAY

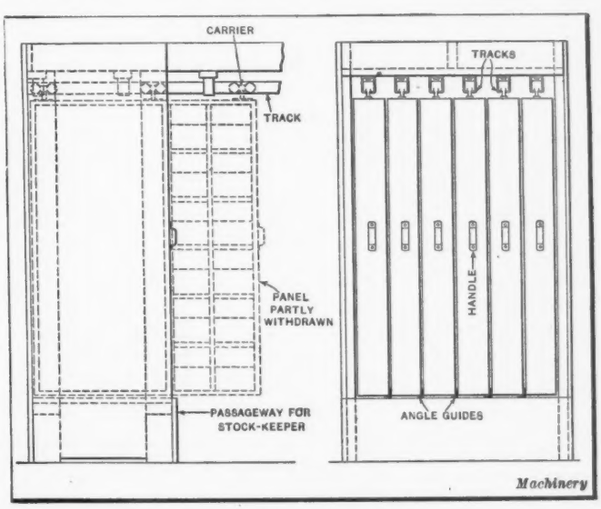
FIGURING IN THE METRIC SYSTEM

With reference to the article entitled "Figuring in the Metric System" on page 939 of the June number of MACHINERY, the writer would add a few words of warning to those employed on government work. On the Ordnance Department drawings, the dimensions are often expressed in both inches and millimeters, the latter being placed in parentheses; for instance, (5) 0.1968 ± 0.005. The inches are usually carried to four decimal places, but in many cases they are carried only to three. Dropping a few ten-thousandths of an inch here and there may make no difference in many cases, but when we consider special forms of threads, one must be sure to find out which figures are governing. On the pitch this difference is likely to cause an error that is by no means small. In view of this fact, when reading a drawing one may have to work half in the English system and half in the metric.

Hartford, Conn. THOMAS A. REILLY

TOOL AND STOCK STORAGE CABINETS

The storage cabinet here illustrated is unique and at the same time perfectly practical. This system of construction makes it possible to keep a large assortment of stock or tools in a small, compact space, and yet allows easy access to any article. The material is as well cared for as when placed in closed cabinets or shelving. It is especially adapted to use in tool distributing rooms where such small tools as drills, reamers, taps, threading dies, milling cutters, arbors, etc., are kept but is equally well suited for keeping the stock of screws, bolts, nuts, washers, or other small parts generally kept in small quantities in toolmaking and diemaking departments. Where larger quantities of material are stored, other systems, such as stationary bins, are better suited to the requirements on account of the excessive weight. Each cabinet contains one or more panels, each of which is suspended from the top by two ball bearing rollers or carriers operating in rectangular hollow metal tracks. The bottom of the track should not be less than



Tool and Stock Storage Cabinet

6 feet 6 inches from the floor to allow head room for the keeper to walk beneath. The cabinet illustrated contains six panels, but the number is limited only by the requirements. The lower end of each panel is guided between two steel angles. Small bins or sections are built into the panels when required to accommodate the material to be stored, but such tools as milling cutters or circular forming tools are generally hung on pins fastened to the upright members of the panels. Drills, reamers, etc., are best accommodated when kept on inclined shelves with small raised partitions.

When stock is to be withdrawn, the panel containing the articles desired is drawn forward from its normal position in the cabinet, as shown by the dotted lines. A substantial bow-shaped handle attached to the front of the panel will be found convenient in moving it. The contents should be plainly

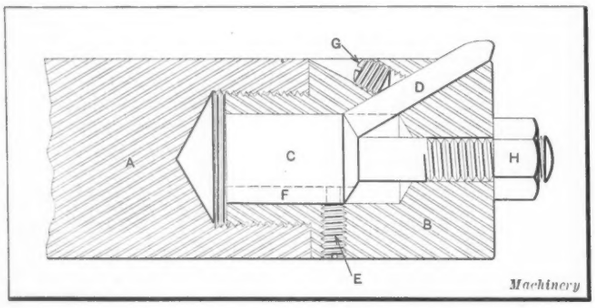
marked on the front of each panel. The depth of the panels can be varied to meet requirements, but a depth exceeding three feet would be rather inconvenient to handle, on account of the long arm movement necessary in drawing them forward. The entire cabinet may be made of wood or metal, the wood construction being less expensive. On account of the simple design, it can be built in any shop. It is a good plan to arrange a double row of cabinets with an equal number of panels on each side, all opening toward the center passageway. This permits the stock-keeper to draw material from either row of cabinets.

One particularly valuable feature of this system of storage is the very small space required, without interfering with the easy access to the material. Another important feature is the ease with which the equipment can be extended to enlarge its capacity, it only being necessary to provide additional panels as required.

Aurora, Ill. ELLIS J. G. PHILLIPS

ADJUSTABLE CUTTER-HEAD

A boring-bar or cutter-head that is easily made is shown in the accompanying illustration. It consists simply of a bar *A* into which the cutter-head *B* is screwed. The head is recessed for the center bolt *C*, the bevel seat of which is in contact with the heel of the cutting tool *D*. A pilot-point set-screw *E*,



Construction of an Adjustable Cutter-head

which works in a groove *F*, prevents the center bolt from turning, while set-screw *G* holds cutter *D* firmly in position. The position of the cutter is adjusted by means of the nut *H* on the end of the center bolt.

Detroit, Mich. C. C. SPREEN

FIXTURE FOR MILLING CYLINDER HEADS ON ENGINE LATHE

The fixture shown in the accompanying illustrations is designed for milling gasoline motor cylinder heads on an engine lathe. The depth of the cut required in finishing the milled surface of the casting is 5/32 inch, and the surface milled is 26 inches long by 8 inches wide. The milling cutter is held in the lathe spindle and the work brought into contact with the end of the cutter, as shown in Fig. 1. The fixture for holding the work is bolted to the top of the lathe carriage. This fixture allows the work to be fed across the end of the milling cutter at right angles to the spindle, and it is so

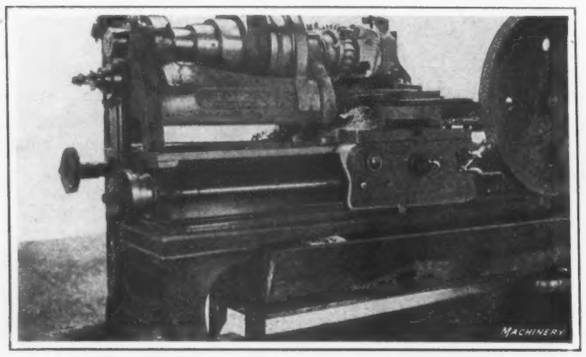


Fig. 1. Front View of Engine Lathe with Fixture and Work in Place

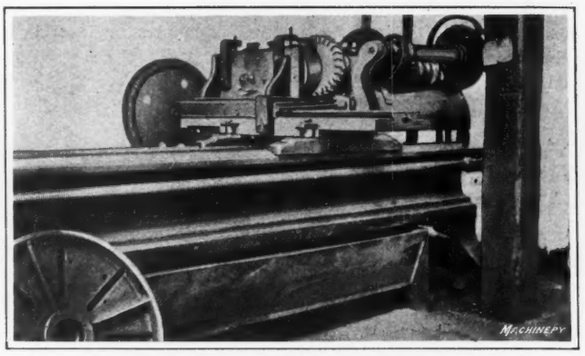


Fig. 2. Rear View of Lathe showing Method of holding Work

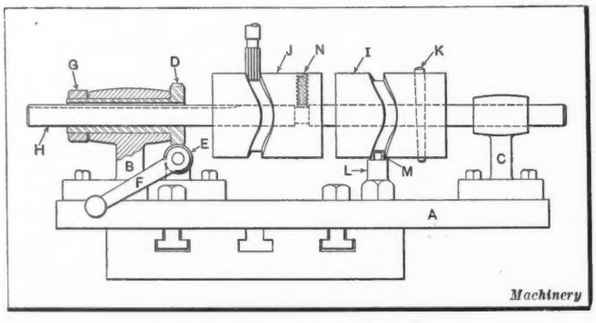
designed that a uniform rate of feed can be easily maintained by means of a heavy balanced handwheel attached to the end of the fixture lead-screw. The depth of the cut is controlled by moving the carriage of the lathe.

Fig. 1 shows the front of the lathe with the fixture and work in place, and Fig. 2 shows the back of the lathe. The latter illustration shows clearly the angle-plate on which the work is mounted, and also the method of holding the work firmly in place. From thirty-five to forty-five castings are finished in ten hours by this method, and the surface milled is true within the limits of accuracy required.

Milwaukee, Wis. FRED FRUHNER

CAM CUTTING ON A DRILLING MACHINE

The accompanying illustration shows a method employed for cutting barrel cams on a drilling machine in a shop not equipped with a milling machine. Plate *A* is fastened to the table of the drilling machine, and supports the two stands *B* and *C*. Stand *B* forms a bearing in which the sleeve of worm-wheel *D* rotates when driven by worm-shaft *E*. Worm-shaft *E* has its bearing in a bracket that is part of stand *B*. Crank *F* provides for a hand feed, but this was replaced by a grooved

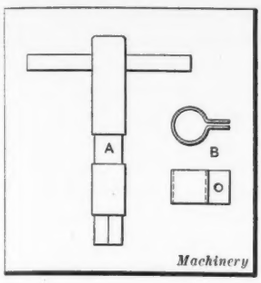


Cam Cutting Attachment for Drilling Machine

wheel driven by a round belt from an overhead shaft after the operator became more familiar with the work. Worm-wheel *D* is held in its bearing by collar *G*. Shaft *H* carries the work *J* and the master cam *I*. The shaft turns freely in bearing *C*, and is allowed to slide in the sleeve of worm-wheel *D*. The sleeve of worm-wheel *D* has a key which fits into a key-way in shaft *H*; this allows shaft *H* to turn only when worm-wheel *D* is turned by worm *E*. The work *J* is fastened to shaft *H* with a set-screw *N*, as shown; the shaft is turned down slightly smaller where the set-screw is located, so that the burr caused by the set-screw will not prevent the removal of the shaft. Master cam *I* is pinned to the shaft by a taper pin *K*. The stud *L* is fitted with a roller *M* that fits in the groove of the master cam. When shaft *H* is turned by means of worm *E*, the groove in the master cam, coming in contact with roller *M*, imparts a sliding movement to shaft *H*, so that, when the end-mill is fed down on the blank cam *J*, it forms a groove which is a reproduction of the groove in the master cam. The finished cam is removed by knocking out taper pin *K*, loosening set-screw *N*, and withdrawing the shaft.

Camden, N. J. THOMAS JAMES

SHOP AND DRAFTING-ROOM KINKS



Device for securing Wrench to Lathe to prevent it from being lost

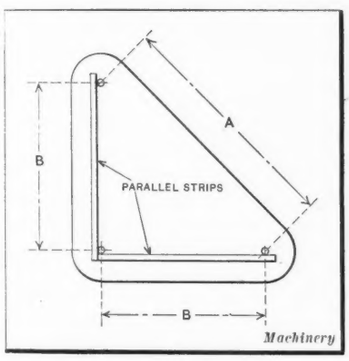
TO PREVENT CHUCK WRENCH FROM BEING LOST

As a means of preventing the chuck wrench of a lathe from becoming lost, the wrench may be turned down, as shown at *A* in the illustration, and strap *B* securely fastened in the reduced portion. A chain is attached to *B*, the other end of which may be secured to the lathe.

New York E. J. HIGGINS

SQUARE TEST GAGE

The illustration shows a gage that is useful in checking the squares of toolmakers and inspectors. Three hardened and ground plugs are set in a well-ribbed and seasoned cast-iron base. These plugs are placed by the button method and checked by either a micrometer or Johansson gage. The distances from center to center may be varied to accommodate different sizes of squares, or an accurate parallel strip may be used over the plugs. The dimension $A = \frac{B}{\sin 45 \text{ degrees}} = \frac{B}{0.70711}$. The variation or error of the squares may be checked either by Johansson blocks or tissue paper feelers.

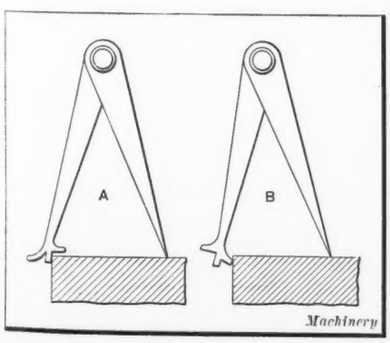


Gage for testing Squares

Watertown, N. Y. H. V. COULSTON

HERMAPHRODITE CALIPERS

The hermaphrodite calipers shown in the illustration have one leg so shaped that it can be used for internal or external work. When the leg is in the position shown at *A* it is useful for scribing lines on thin work. Ordinary hermaphrodite calipers have a tendency to slip over the side of the stock when used for this purpose, but the cut-out on this type keeps the leg against the stock and an accurate line may be scribed.



Hermaphrodite Calipers that are Useful for scribing Lines

Newark, N. J. GEORGE WERNER, JR.

TO DISTINGUISH HIGH-SPEED STEEL FROM CARBON STEEL

The spark test cannot always be relied upon to distinguish high-speed steel from carbon steel, as steel containing very little tungsten will spark the same as high-speed steel. The nitric-acid test is a good test to use. Nitric acid will "eat" carbon steel immediately, but will not attack at once high-speed steel that contains even a very small amount of tungsten. The surface of the steel tested should be absolutely clean. L.

STRAIGHT-SHANK COUNTERBORE

On small work, where straight-shank drills are used, because they are more easily changed than the taper-shank drills, which must be removed by using a drift, a counterbore



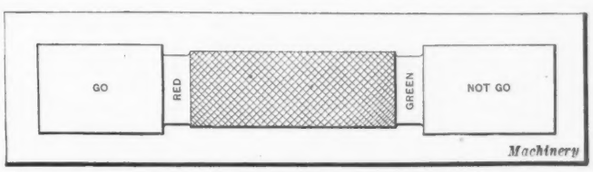
Straight-shank Counterbores that cannot Slip upward

like that here shown is very useful. It cannot slip upward in the chuck, for the shoulder *A* is against the chuck jaws. By using the stop on the drilling machine, a uniform depth of counterbore is assured.

New York City E. J. HIGGINS

DISTINGUISHING MARKS FOR ENDS OF PLUG GAGES

If the necks of plug gages are marked with bands of strong contrasting colors, the ends will be distinguishable at a glance. This plan will permit a much more rapid use of the gage,



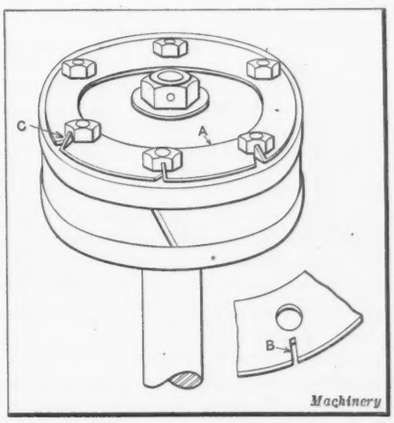
Plug Gages marked so that Ends are easily distinguished

for no time need be spent in looking for the figures stamped on each end or for the words "Go" and "Not Go." There will also be much less chance of error due to using the wrong end.

Detroit, Mich. C. C. SPREEN

NUT-LOCK PLATE

While on an engine repair job the writer saw a kink that seemed worth passing on to the job shop machinist and others. The illustration shows a lock plate used to hold on the follower plate nuts of a steam engine piston. The circular ring, or plate *A*, was 3/32-inch plate steel; the holes were drilled for the studs or bolts and a slot was cut on the outside edge to within 1/4 inch of each hole, as shown at *B*. The lock plate was put on and the nuts all set up tight; then with a cold chisel the tab was bent up against the flat of the nut side, as shown at *C*.



Nuts held in Place by Lock Plate

C. H. WILLEY
Concord, N. H.

HOW AND WHY

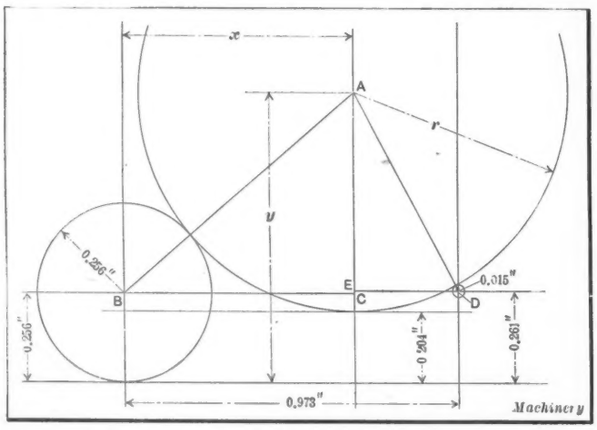
QUESTIONS ON PRACTICAL SUBJECTS OF GENERAL INTEREST

A GEOMETRICAL PROBLEM

I. E. S.—Referring to the illustration, please show how to find the distances x, y, and r from the dimensions given.

Answered by J. J. Clark, Scranton, Pa.

A.—There appear to be three unknowns, but there are only two in reality, since y can be found immediately as soon as r is known. Draw the vertical line AC and the horizontal lines BC and DE; join A and B and A and D. In the right triangles ACB and AED, $BC = x$, $AC = y - 0.256$, $AB = r + 0.256$,



A Geometrical Problem

$DE = 0.973 - x$, $AE = y - 0.261$, and $AD = r + 0.015$. But $y = r + 0.204$; hence, $AC = r + 0.204 - 0.256 = r - 0.052$, and $AE = r + 0.204 - 0.261 = r - 0.057$. Since $BC^2 + AC^2 = AB^2$, $x^2 + (r - 0.052)^2 = (r + 0.256)^2$; whence, $x^2 + r^2 - 0.104r + 0.002704 = r^2 + 0.512r + 0.065536$, and

$$x^2 - 0.616r = 0.062832 \quad (1)$$

Also, since $DE^2 + AE^2 = AD^2$, $(0.973 - x)^2 + (r - 0.057)^2 = (r + 0.015)^2$; whence, $0.946729 - 1.946x + x^2 + r^2 - 0.114r + 0.003249 = r^2 + 0.03r + 0.000225$, and

$$x^2 - 1.946x - 0.144r = -0.949753 \quad (2)$$

Multiplying Equation (2) by 77 and Equation (1) by 18, we have:

$$77x^2 - 149.842x - 11.088r = -73.130981 \quad (3)$$

$$18x^2 - 11.088r = 1.130976 \quad (4)$$

Subtracting Equation (4) from Equation (3), $59x^2 - 149.842x = -74.261957$, from which $x = 0.675001$ inch, or 1.86469 inch. Evidently, the smaller value is the one desired in this case. Substituting this value of x in Equation (1), $0.675001^2 - 0.616r = 0.062832$; from which $r = 0.63766$ inch. Finally, $y = 0.63766 + 0.204 = 0.84166$ inch.

FORMATION OF BLOW-HOLES IN BABBITTED BEARINGS

F. T.—We have had difficulty in babbitting the bearings required for the turbines of torpedo boat destroyers. These bearings vary in diameter from 5 to 14 inches and in length from 5 to 18 inches. The babbitt metal, which is very hard, is heated to 500 degrees C. (932 degrees F.), but blow-holes and very small pin-holes form in the lining.

A.—The formation of blow-holes in babbitted bearings is not always due to the same cause, and several sources of trouble will be mentioned. To begin with, the ladle from which the babbitt is poured should preferably have a rounded spout, rather than one which is sharp or broad, because a broad, thin stream of metal tends to produce porous areas or blow-holes. Before the babbitt is poured, it should also be stirred thoroughly to insure a lining of uniform composition. Oil on the surface of a babbitted mandrel tends to cause the babbitt to blister. It is the practice of a prominent electrical concern to cover the mandrel with a thin coating of clay wash by plunging the mandrel while heated into a pail containing a solution of one or two pounds of Jersey red clay. When the mandrel is dry, it is covered with a thin clay coating, which prevents the formation of blow-holes and gives the babbitt lining a smooth surface.

When heating the babbitt metal, the temperature should be increased slowly, especially when melting new babbitt or when old babbitt is being remelted. The metal should be stirred at frequent intervals, and it is advisable to cover the surface of the molten babbitt with powdered charcoal or graphite to reduce oxidation. The mandrel temperature is right when water evaporates rapidly from its surface without spluttering. Babbitt metal, as a rule, should be kept at a constant temperature of about 870 degrees F., although the exact temperature depends somewhat upon the composition. If the babbitt is poured at too low a temperature, the lining will have a coarse granular formation, and if the shell or casting and the mandrel are too cold, blow-holes and other defects will result. On the other hand, if the temperature of the metal is too high, it will cool too slowly and the heavier elements will have time to settle, thus producing a bearing which is soft at one place and brittle at another.

The iron shell to be lined with babbitt should be preheated to a temperature of from 200 to 300 degrees F. before pouring, the higher temperature being preferable unless the shell is very heavy. The preheating should be done in an oven, although a gas or coke fire may be used, in which case the surface to be babbitted should be turned upward away from the fire, as otherwise a deposit may be formed which will prevent the babbitt from adhering properly. The best results are obtained by pouring the babbitt with the bearing in a vertical position.

A DRAFTSMAN'S PROBLEM

J. F.—Referring to the illustration, please show me how to find the distances a, b, c, and d; I should like a method that will cover all similar cases.

Answered by J. J. Clark, Scranton, Pa.

A.—Draw NB parallel to GA; join N and O; draw OC and OD perpendicular to NB and NM, respectively; draw MA perpendicular to GA. Angle $DOC = MNB$, and sin $MNB =$

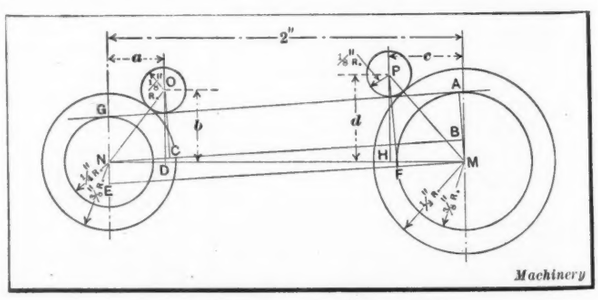


Diagram illustrating a Draftsman's Problem

$\frac{MB}{MN} = \frac{\frac{3}{8} - \frac{1}{4}}{2} = 1/16 = 0.0625$; therefore angle $MNB = 3$ degrees 35 minutes. In the right triangle NOC, cos $NOC = \frac{OC}{ON} = \frac{\frac{1}{4} + \frac{1}{8}}{\frac{3}{8} + \frac{1}{8}} = \frac{3}{4} = 0.75$; therefore angle $NOC = 41$ degrees 24 minutes 35 seconds. $ONC = 90$ degrees $-$ 41 degrees 24 minutes 35 seconds $= 48$ degrees 35 minutes 25 seconds. $OND = ONC + CND = 48$ degrees 35 minutes 25 seconds $+ 3$ degrees 35 minutes $= 52$ degrees 10 minutes 25 seconds. $OD = \frac{1}{2} \times$ sin $OND = \frac{1}{2} \times$ sin 52 degrees 10 minutes 25 seconds $=$

$\frac{1}{2} \times 0.78988 = 0.39494$ inch $= b$. $ND = \frac{1}{2} \times \cos OND = \frac{1}{2} \times \cos$ 52 degrees 10 minutes 25 seconds $= \frac{1}{2} \times 0.61327 = 0.30664$ inch $= a$. Draw ME parallel to GA; draw PF and PH perpendicular to ME and MN, respectively. Angle $FPH = EMN = MNB$. Cos $FPM = \dfrac{\frac{1}{8} + \frac{1}{4} + \frac{1}{8}}{\frac{1}{2} + \frac{1}{8}} = 4/5 = 0.8$; therefore angle $FPM = 36$ degrees 52 minutes 11 seconds. Angle $HPM = FPM + FPH = 36$ degrees 52 minutes 11 seconds + 3 degrees 35 minutes $= 40$ degrees 27 minutes 11 seconds. $HM = \frac{5}{8} \times \sin HPM = \frac{5}{8} \times \sin$ 40 degrees 27 minutes 11 seconds $= \frac{5}{8} \times 0.64882 = 0.40551$ inch $= c$. $HP = \frac{5}{8} \times \cos HPM = \frac{5}{8} \times \cos$ 40 degrees 27 minutes 11 seconds $= \frac{5}{8} \times 0.76094 = 0.47559$ inch $= d$.

Formulas expressing the values of a, b, c, and d are rather awkward, but may be written as follows: let R and r be the radii of the larger and smaller of the two circles at the left; let R_1 and r_1 be the radii of the larger and smaller of the circles at the right; let r_2 be the radius of the fillet circles, and s the distance between the centers; then

$$a = (R + r_2) \cos \left(\cos^{-1} \frac{r + r_2}{R + r_2} + \sin^{-1} \frac{r_1 - r}{s} \right)$$

$$b = (R + r_2) \sin \left(\cos^{-1} \frac{r + r_2}{R + r_2} + \sin^{-1} \frac{r_1 - r}{s} \right)$$

$$c = (R_1 + r_2) \sin \left(\cos^{-1} \frac{r_1 + r_2}{R_1 + r_2} + \sin^{-1} \frac{r_1 - r}{s} \right)$$

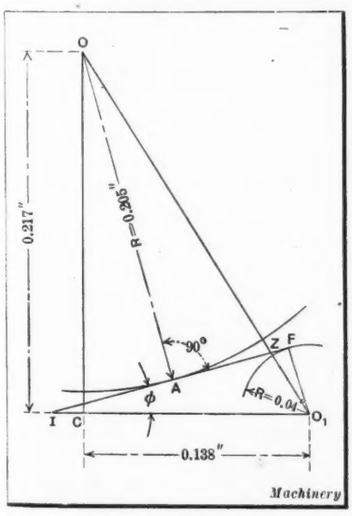
$$d = (R_1 + r_2) \cos \left(\cos^{-1} \frac{r_1 + r_2}{R_1 + r_2} + \sin^{-1} \frac{r_1 - r}{s} \right)$$

PROBLEM IN TRIGONOMETRY

C. E. M.—Referring to the accompanying illustration, please show how to find the angle ϕ. I should like to have the method explained in detail.

Answered by G. H. MacCullough, Worcester, Mass.

The following is a simple solution of the "Problem in Trigonometry" appearing in the July number of MACHINERY, page 1042. By omitting two unnecessary construction lines, and connecting O and O_1, the figure here shown is obtained. In the right triangle OCO_1 the hypotenuse $OO_1 = \sqrt{OC^2 + O_1C^2} = \sqrt{0.217^2 + 0.138^2} = 0.25716$. By construction, it is evident that triangles OAZ and O_1ZF are similar. The proportion $\dfrac{O_1Z}{OZ} = \dfrac{O_1F}{OA}$ is therefore obtained. Adding 1 to both sides, $\dfrac{O_1Z}{OZ} + 1 = \dfrac{O_1F}{OA} + 1$. Changing to fractions, $\dfrac{O_1Z + OZ}{OZ} = \dfrac{O_1F + OA}{OA}$. Substituting the values given, $\dfrac{0.25716}{OZ} = \dfrac{0.040 + 0.205}{0.205}$. Solving, $OZ = 0.21518$. Cos angle $AOZ = \dfrac{AO}{OZ} = \dfrac{0.205}{0.21518} = 0.95270$. Angle $AOZ = 17$ degrees 41 minutes 33 seconds. The tangent of angle $O_1OC = \dfrac{O_1C}{OC} = \dfrac{0.138}{0.217} = 0.63594$. Angle $O_1OC = 32$ degrees 27 minutes 15 seconds. Angle AOC = angle O_1OC — angle $AOZ = 32$ degrees 27 minutes 15 seconds — 17 degrees 41 minutes 33 seconds = 14 degrees 45 minutes 42 seconds. Now the angles AOC and FIO_1, or angle ϕ, are equal, since their corresponding sides are perpendicular. Therefore, angle $\phi = 14$ degrees 45 minutes 42 seconds.



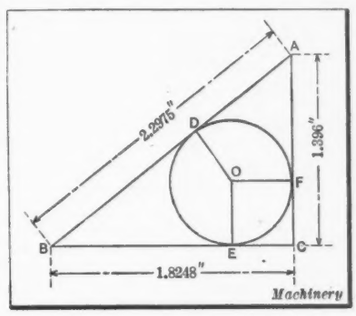
Problem in Trigonometry

TO FIND RADIUS OF CIRCLE INSCRIBED IN TRIANGLE

A. S.—In a right triangle having the dimensions shown in the accompanying illustration, a circle is inscribed; please show how to find the radius of the circle.

Answered by Guy H. Gardner, New London, N. H.

Another solution of the problem given in the July number of MACHINERY, page 1042, is given in the following; it is remarkably simple and easily understood. In the accompanying illustration, $BD = BE$ and $AD = AF$, because "Tangents drawn to a circle from the same point are equal." $EC = CF$, and $EC =$ radius OF. Then let $R =$ radius of inscribed circle. $AC - R = AD$ and $BC - R = DB$. Adding, $AC + BC - 2R = AD + DB$. $AD + DB = AB$; hence, $AC + BC - AB = 2R$. Stated as a rule, "The diameter of a circle inscribed in a right triangle is equal to the difference between the hypotenuse and the sum of the other sides." Substituting the given dimensions, we have $1.8248 + 1.3959 - 2.2975 = 0.9232 = 2R$, and $R = 0.4616$.



To find Radius of Circle inscribed in Triangle

This solution was also submitted by A. B. Subia, Hyland Park, Mich.

TO FIND RADIUS OF CIRCLE

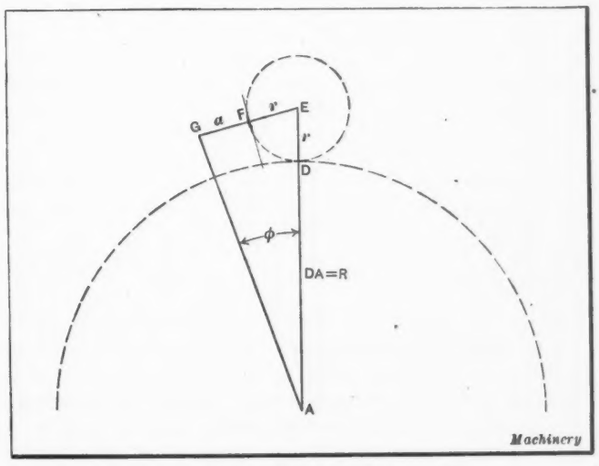
Answered by G. H. MacCullough, Worcester, Mass.

The formula for finding the radius of a circle as given in the July number of MACHINERY can also be derived as follows: Given EG perpendicular to AG, segment $FG = a$, $AD = R$, and the angle ϕ; to find r. $GE = a + r$, and $AE = R + r$. Then the triangle AEG is a right triangle, and $GE = EA \sin \phi$. Substituting the values for GE and AE found above:

$$a + r = (R + r) \sin \phi = R \sin \phi + r \sin \phi$$

$$r (1 - \sin \phi) = R \sin \phi - a$$

$$r = \frac{R \sin \phi - a}{1 - \sin \phi}$$



Finding Radius of Circle

BASIS OF EMPLOYES' COMPENSATION PAYMENTS

BY CHESLA C. SHERLOCK[1]

The amount of compensation that an injured workman may recover is generally based upon the average weekly wages he has earned for the full year next preceding the date of injury. Just what is meant by this expression of the statute has caused a wide difference of opinion among the authorities. The California commission has decided that tips or gratuities received in addition to the regular salary should not be considered a part of the workman's earnings when determining the basis of a compensation award. It was argued that such were earnings, that they were reasonably certain, and that the average amount earned in a given time could easily be ascertained. But the opinion was handed down on the ground that if the court took the contrary view it would present too great an opportunity for fraudulent claims being presented to the commission from time to time, there being no way of proving earnings from tips, other than by taking the injured man's word for it. The court in Texas took a contrary view and allowed compensation to a porter of a hotel whose sole income consisted of tips. The same conclusion was reached by the Massachusetts court, allowance being made by the court for the amount of earnings over and above the regular salary received from the employer.

Computing Compensation of Seven-day Worker

In cases where the injured man is a seven-day worker, the question arises as to whether or not he can be allowed compensation computed on a seven-day or a six-day basis. There is a considerable difference in the amount of compensation paid, and it is a fruitful source of dispute among employers and injured workmen. This is especially the case in industrial occupations. The California commission refused to permit seven-day workers to receive compensation on a computation on a six-day basis; it fixed 332 days as the average number of working days in the year and based computation upon that figure rather than 300, as is the case of a six-day worker.

Compensation when Injured at Other than Usual Occupation

Workmen are often injured at a time when they are engaged in work apart from their usual occupation. If there is a difference in the wages allowed for the different kinds of work, the question naturally arises as to whether the wage of the usual occupation should govern or whether the wage of the occupation engaged in at the time of the injury should govern. An example of such a case is where a carpenter was temporarily engaged in washing windows. As a carpenter, he would receive $5 a day, while as a window washer he would be entitled to only $1.50 a day. The California and Connecticut courts have said that the wage of the work being done at the time of injury will govern—not the wage of the usual occupation. In a California case, a lineman who customarily earned $4.50 a day was injured while in the National Guard, where he received only 70 cents a day and board. The commission made the award on the basis of employment in the National Guard and not as a lineman.

In a Wisconsin case, a citizen was killed while obeying a summons to aid an officer in making an arrest. The Supreme Court of that state made the award, not upon the basis of occupational earnings, but upon the basis of the usual pay for police services in the locality. The Massachusetts court, however, does not take kindly to this construction of the acts, and has held that if a workman capable of earning a higher wage is injured while temporarily employed, he is entitled to an average of his earning power. It is necessary, however, to prove that he is able to earn the higher wage.

Part Service for Several Employers

The Maryland commission has said that where an employe is rendering part-time services for one employer, with the privilege of serving other employers, the basis of a compensation award will be the average weekly earnings that he receives from all sources, and not merely the amount received from the employer in whose services he is at the time of the injury. In a California case it was shown that a watchman was employed by several steel mills and industrial concerns to work for them jointly. He was killed by a burglar while on the premises of one employer. The commission held that his dependents were entitled to an award based upon the combined earnings from all employers, and not merely from the amount of earnings received from the employer upon whose premises he happened to be at the time of his death. The payment of compensation, however, was to be made by the employer upon whose premises the workman was killed.

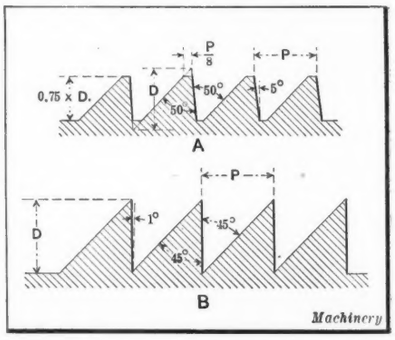
Over-time Earnings and Intent of Law

The question of whether over-time earnings should be considered in arriving at the average weekly earnings of the injured workman has caused a great deal of litigation before the courts and commissions. It seems to be the consensus of opinion, however, that over-time earnings should not be considered in arriving at the average weekly wages. The intent of the law is to be entirely fair to both parties concerned, although it is sometimes hard to make them understand this. It is desired to ascertain, if possible, the average income of the workman from his employment and then divide the loss equally between the workman and the employer. That, in a nutshell, is the whole purpose of the compensation acts.

* * *

HARVEY GRIP THREADS

The Harvey grip thread has an included angle of 45 or 50 degrees, but the thread section is not symmetrical about a line at right angles to the axis of the bolt or threaded body. Apparently there is no standard slope to which the sides of the thread should be cut in reference to a line at right angles to the axis, as indicated by the accompanying illustration. At *A* is shown one form used, in which one side of the thread forms an angle of 5 degrees with a line at right angles to the axis, while in the form shown at *B* the corresponding side forms an angle of only 1 degree. While both threads are known as the Harvey grip thread, they vary in several respects. The thread shown at *A* is not a sharp V-thread, the flat at the top and bottom being equal to the pitch divided by 8. The thread shown at *B* is the form of Harvey grip thread shown in MACHINERY'S HANDBOOK. It is a sharp V-type thread having an included angle of 45 degrees.



Two Types of Harvey Grip Threads

* * *

Nearly 300,000 men had been transferred, about the end of June, from one unit to another in army camps in this country as a result of occupational qualifications ascertained through the Committee on Classification of Personnel of the Adjutant General's office. About 40,000 transfers have taken place each week recently. In some of the camps, where as many as 2500 men are received daily, a force of 200 trained interviewers is employed to ascertain full information regarding the men's occupations, education, experience, and special qualifications. It is necessary for enlisted men leaving this country to make out an occupational card, which enables officers on the other side to place them where they can be most useful. Among men now being transferred because of occupational qualifications are mechanics, chauffeurs, chemists for gas defense work, physicists and meteorologists for aviation purposes, surgical-instrument repairers, bacteriologists, map draftsmen, refrigeration experts, crane operators, foresters, railroad builders, railway shop workmen, accountants, gunsmiths, and other ordnance specialists and workmen for engineer regiments.

[1]Address: Box 604, Des Moines, Iowa.

Machining an Automobile Differential Cross

By Albert A. Dowd[1]

WHEN alloy steels are used in automobile construction and when parts made from this material are hardened and ground after the machining operations have taken place, the possibility of distortion during hardening must be given consideration. In certain kinds of work, such as the large ring gear in the rear axle construction, the greatest pains are taken in the hardening process to obviate any chance of distortion. This is attended to by placing the gear in a kind of clamp the function of which is to prevent any alteration taking place due to the heat-treatment. On some of the other parts, however, a clamp is not used, and the pieces therefore become more or less distorted in the hardening process. The allowance for grinding is usually sufficient to take care of a small amount of change, but there are some instances where trouble is likely to be caused unless due preparation is made to counteract the changes caused by hardening.

An excellent example of this kind is the differential cross used to support the pinions in the differential case of an

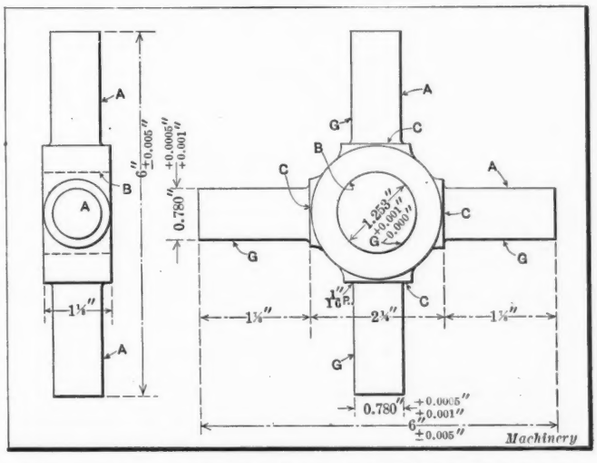


Fig. 1. Cross for supporting Pinions of Automobile Differential Case

automobile, shown in Fig. 1. Reference to this illustration will show that there are four arms *A* arranged radially at 90 degrees from each other and equidistant from the center hole *B*. These arms are used to support the pinions in the differential and it is necessary that they should be in the proper relation to one another. The center hole is not of great importance, but it is machined rather accurately in order to assist in obtaining the correct relation of the arms. The shoulders *C* must also be equidistant from the center. Now it will be noted that the work is hardened and ground after machining, and as the arms of the cross are turned on centers it might be assumed that these would be in the correct relation to one another after hardening, provided they were located properly in the first place. As a matter of fact, however, there would be more or less change in their relation so that it would be unsafe to use the centers in the final grinding operation. In order then to make sure that the arms will be correctly ground the various operations must be carefully planned. In the case of this particular piece, the operations given in the following were decided upon.

[1]Address: Care of Service Engineering Co., 25 Church St., New York City.

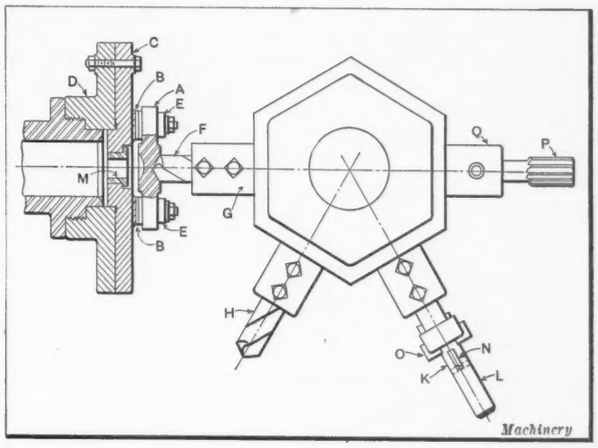


Fig. 2. Set-up for drilling, boring, reaming, and facing Hub

Sequence of Operations

The sequence of operations on the work is as follows: (1) drop-forge and trim; (2) anneal and pickle; (3) spot, drill, bore, and ream 1.253-inch hole, and face hub; (4) face other side of hub; (5) straddle-mill ends of arms; (6) center arms; (7) turn arms, cut fillet, and face ends; (8) harden; (9) grind two opposite arms; (10) grind 1.253-inch hole; (11) grind one other arm, working from hole to centers in previously ground arms; (12) grind arm opposite last one ground; (13) inspect. This sequence of operations simply indicates the work which is done in each operation, but does not take up the matter in detail. This will be taken care of in the following description.

Turret Lathe Operations

Referring to Figs. 2 and 4, the setting up of the turret lathe for the third operation on the work is clearly indicated, as is also the presentation of the various tools to the work. In Fig. 2, the work *A* is located in V-blocks *B* on a

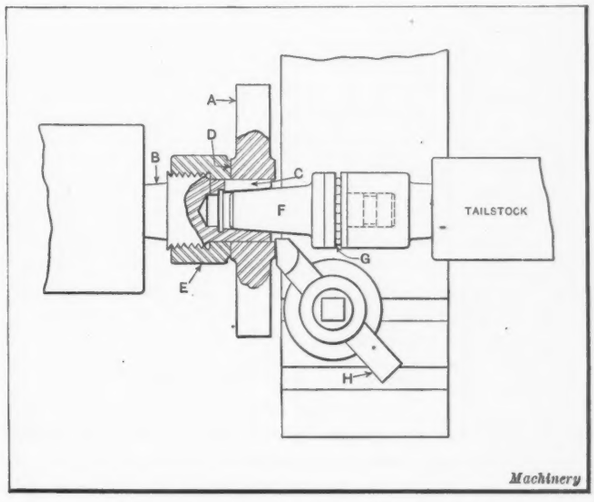


Fig. 3. Expansion Arbor for Facing Operation

faceplate fixture *C* which is mounted on an adapter *D*, screwed to the spindle of the machine. The work is clamped by means of a strap *E*. The first tool used is a spotting drill *F* in a standard holder *G*. This tool is followed by a drill *H* and a boring and facing bar *K* having a pilot which enters the bushing *M* in the faceplate fixture. The boring and facing bar is provided with cutters *N* and *O* for boring and facing, respectively. The reamer *P* is of the floating type held in a special holder *Q*. The reaming of the piece completes this operation, but it will be noted that only one side of the large hub has been faced.

Facing Other Side of Hub

Having machined the hole and faced one side of the hub, the other side must now be faced off square with the first side. A 14-inch engine lathe is used for this operation with a special arbor as indicated in Fig. 3. This arbor is of the expanding type and is held in the spindle by a tapered shank *B* in the usual manner. The work *A* is slipped onto the portion *C* of the arbor until the finished face *D* comes to rest against the collar *E*. This collar is threaded on the arbor and simply

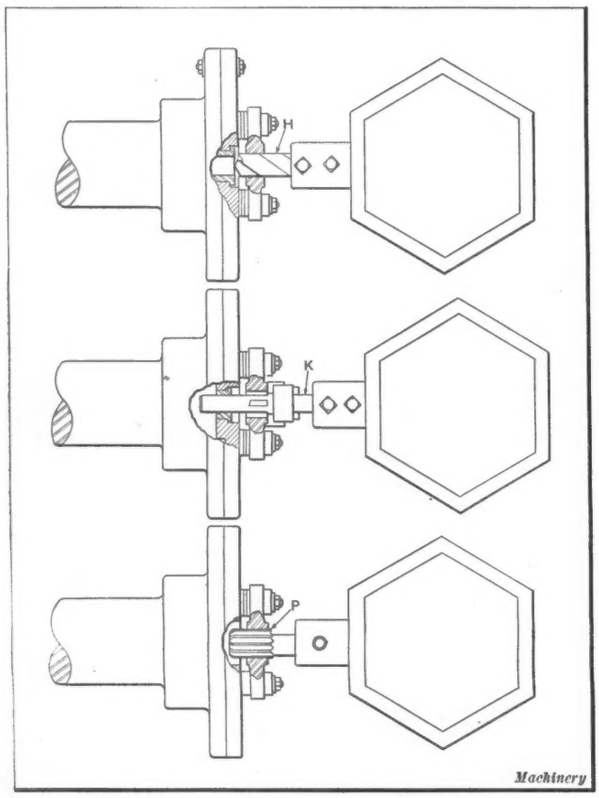


Fig. 4. Drilling, boring, reaming, and facing Hub

acts as a longitudinal stop, although it is also intended to be used as a knock-off in case the work should stick. The end of the arbor *C* is split in three places longitudinally to allow for expansion. The inside is tapered to fit a plug *F* mounted in the tailstock and having a ball thrust bearing *G* behind it as indicated.

After the work is placed on the arbor, the tailstock is brought up quickly until the tapered plug *F* enters the hole and expands the arbor in the work, thus holding it squarely. The tool *H* is used for facing the end of the hub. It will be seen that the method indicated is very rapid, and while it is not new in its application, it will be found useful for certain classes of work.

Index Fixture for Straddle-milling

The next operation on the work consists in straddle-milling the ends of the arms *B* and *C*, Fig. 5. For this purpose the work is placed on a fixture *E*, being located on a central stud *L* with the arms *B* and *C* resting in V-blocks. The upper half of this fixture is made so that it can be readily

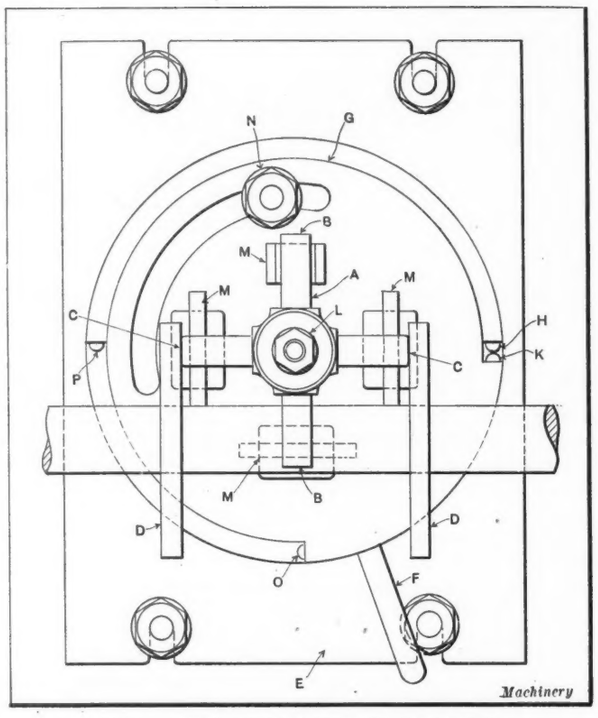


Fig. 5. Fixture for straddle-milling Ends of Cross

indexed by means of the lever *F*. The straddle-milling cutters *D* face across the ends of the arms when in the position shown. The hardened pins *H* and *K* give the correct radial location, and the clamping of the fixture at a given point is accomplished by means of the nut at *N*. After the two arms *C* are milled, the lock-nut *N* is loosened and the lever moved around until the hardened pin *O* strikes against another pin *P*. This gives the correct position for the second milling of the arm *B*. After this work has been done, the arms should be uniform in length about the center hole.

Box Jig for Centering the Arms

In order to take no chances with an indexing fixture for putting the center hole in the arms, a box jig, shown in Fig. 6, was used. The work is placed on a central stud *A* in the four-sided box jig *B*, and it is held firmly against a finished surface by means of the wedge *C*. A combination center

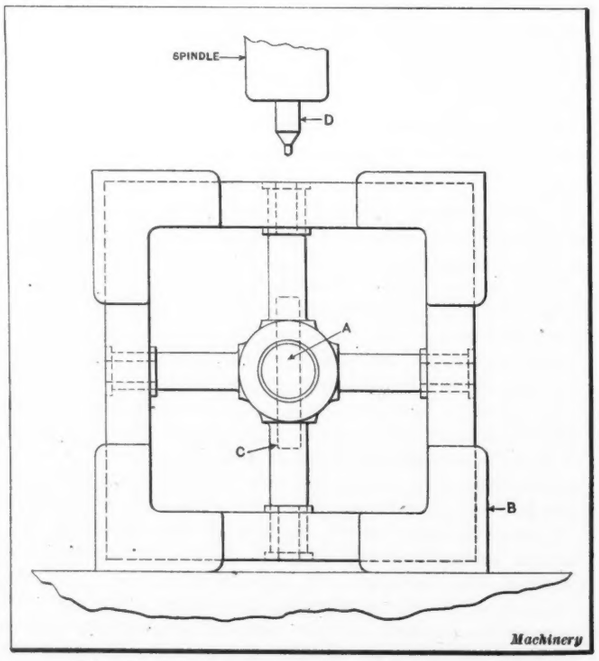


Fig. 6. Box Jig for drilling Center Holes in Arms of Cross

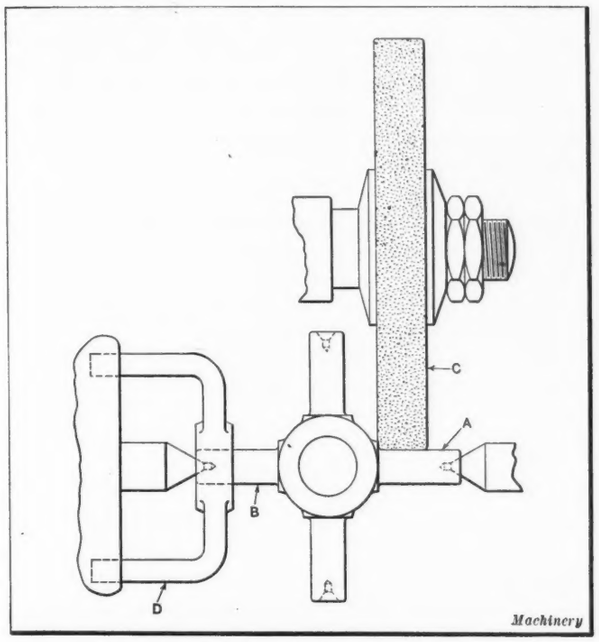


Fig. 7. Method of grinding Two Arms

drill and reamer *D* acts through bushings on each of the four arms consecutively. A fixture of this kind is much to be preferred to an indexing fixture for this operation, because the accuracy can be maintained much more easily. The four holes for centers in the arms are now in their correct relation to one another, and to the center of the work, and it will be understood that these points are determined carefully in order to prevent trouble in the subsequent machining operations.

Rough-turning the Four Arms

The next operation on the work consists in rough-turning the four arms on centers in an engine lathe as indicated in Fig. 10. There is nothing particularly out of the ordinary in this operation except that a special form of driving dog is used as indicated at *B*. This dog is so arranged that there is no screw to tighten, and it can be slipped onto the end of the arm and the lathe started immediately. As pressure is applied to the cutting tools the cam arm on the dog tightens firmly on the work and prevents slippage. The more pressure that is applied, the tighter the dog holds, and yet it can be released in a moment. The work *A* in this operation is held on centers, and the tools *C* and *D* turn the arms and cut the fillet. Immediately after this operation the work is hardened.

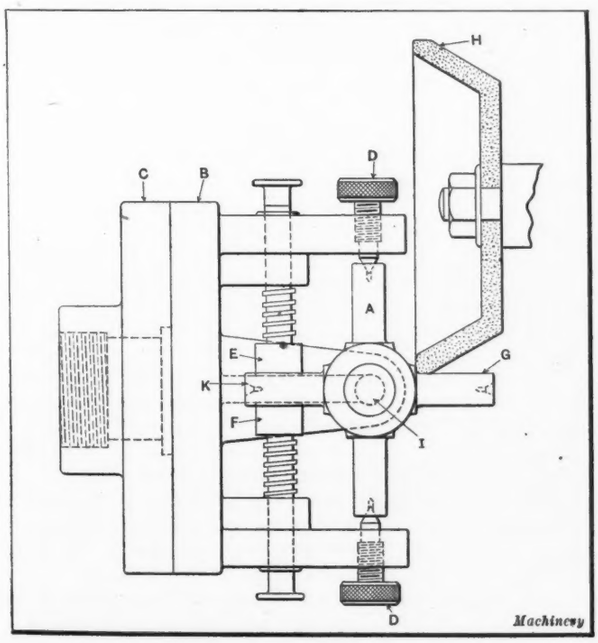


Fig. 8. Fixture for grinding Two Remaining Arms True

Operation after Hardening

Now it will be seen that after a piece of this kind has been hardened, the carefully put in centers may not be in the correct relation to each other. It is also possible that they will not be in alignment with the center hole. For this reason the two arms *A* and *B*, Fig. 7, are first ground on their own centers, reversing the work end for end and grinding with a wheel *C* in the usual manner. The wheel is dressed so as to produce the fillet at the junction of the arms with the center hub. The work is dogged with a two-tailed dog *D*, as indicated, during this operation. Now after grinding these two arms it may be found that they are true with each other but possibly slightly out of alignment with the center hole

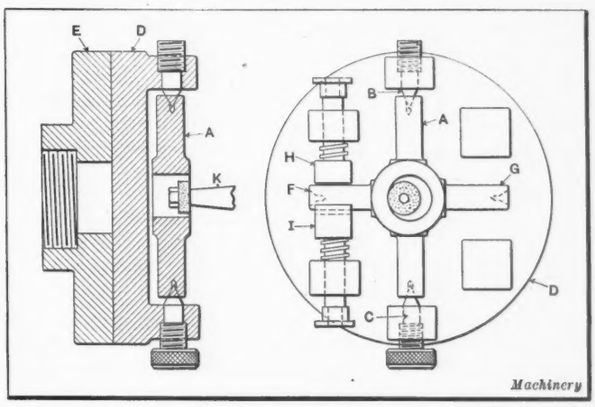


Fig. 9. Fixture for grinding Center Hole in Line with Ground Arms

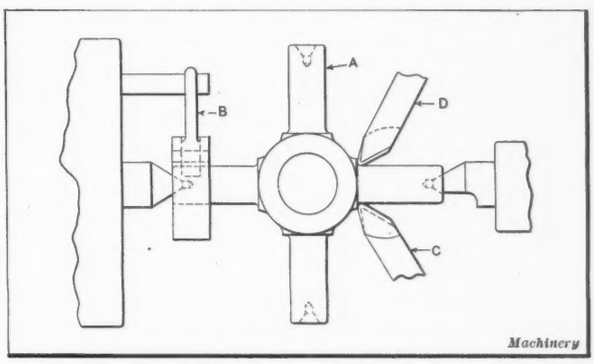


Fig. 10. Special Dog and Tools used in turning Arms of Cross

in the hub. The possibility of inaccuracies between these portions of the piece will be counteracted in the next operation.

First Grinding Fixture

The hole in the center hub is now ground so that it will be in perfect alignment with the two arms ground in the last operation. The work *A*, as shown in Fig. 9, is set up on the two centers at *B* and *C* in a faceplate fixture *D* mounted on an adapter *E* on the live spindle of a cylindrical grinder. Now in order to make sure that the hole will be in the correct relation to the two arms *F* and *G* which have not yet been ground, the arm *F* is located in a spring V-block *I* as indicated. A button, which is also of the spring variety, holds the arm in position in the V-block as shown at *H*. The internal grinding spindle *K* of the machine is utilized for grinding this hole. When this operation is completed, the centers *B* and *C* and the center hole in the hub are in the correct relation to one another.

Final Grinding Operation

The alignment of the two previously ground arms with the center hole in the hub was accomplished by the last operation, but it is not known how the other two arms stand either in relation to the center hole or to each other on

account of possible distortion in hardening. Assuming that they are not true, the work must set up in such a way that location will be obtained by means of the previously ground hole in the hub and the two arms which have also been ground. Fig. 8 shows the final grinding operation on the work. A special faceplate fixture *B* is mounted on an adapter *C* on the live spindle of the machine in the usual manner. The work *A* is set up on a central plug *I* and also on the screw centers *D*, the latter being used in the arms ground in a previous operation. In this setting no other centers can be used on account of the possibility of distortion in hardening. In order to steady the work, however, the spring buttons *E* and *F* are used. The work is entirely unsupported at *G*. A special cup-wheel *H* is used for grinding the outside of the arm and it is formed slightly to produce the fillet at the shoulder. After this work has been done the piece is reversed and the other arm *K* is finished in like manner. After this operation it will be seen that although the hardening process may have caused some distortion in the work, the method of handling after hardening eliminates any inaccuracies and produces work that is correct in every particular. These methods may be successfully applied to other work of a similar nature.

* * *

STANDARDS FOR STEEL ROLLER CHAINS

At the spring meeting of the American Society of Mechanical Engineers, in Worcester, Mass., a joint report of the standards committees of the American Society of Mechanical Engineers and the Society of Automotive Engineers was presented. This report has been approved by the following manufacturers of steel roller chains: Baldwin Chain & Mfg. Co., Worcester, Mass.; Culver-Taylor Chain Works, Detroit, Mich.; Diamond Chain & Mfg. Co., Indianapolis, Ind.; Duckworth Chain & Mfg. Co., Springfield, Mass.; Link-Belt Co., Indianapolis, Ind.; and Whitney Mfg. Co., Hartford, Conn. The report states that, as existing conditions should be disturbed as little as possible during the period of the present war, no new pitches, roller diameters, or widths of chains will be recommended. It also says that it is desirable to reduce the number of chain models in general use to the smallest possible number, and to select from those now made a series of sizes to be known as "Manufacturer's Standard," which will be designated by special numbers that will be used by all manufacturers. The series of pitches recommended are ½, ⅝, ¾, 1, 1¼, 1½, 1¾, 2, and 2½ inches; and the roller diameters and the widths are to be those most nearly approaching five-eighths of the pitch; the trade number should indicate the number of quarter inches in the pitch. The recommended sizes are given in the accompanying table. While models now catalogued will not be discontinued those mentioned in the table will be recommended to the trade as the best-proportioned chains for general use, and as those most likely to be kept in stock.

DIMENSIONS OF STANDARD STEEL ROLLER CHAINS

Manufacturer's Standard Number	Pitch, Inches	Roll Diameter, Inches	Width, Inches	Manufacturer's Standard Number	Pitch, Inches	Roll Diameter, Inches	Width, Inches
2	½	0.306	¼	6	1½	⅝	1
2½	⅝	0.400	⅜	7	1¾	1	1
3	¾	15/32	½	8	2	1¼	1¼
4	1	½	½	10	2½	1 9/16	1½
5	1¼	¾	¾	..	..	...	..

Machinery

The bottom diameter of sprockets should never be over size, and chain lengths should never be under size. The proper meaning of chain width is the exact distance between the inside plates and not the actual length of the roller. Hence, sprockets should always be made sufficiently narrow to allow clearance for chains made in accordance with this definition.

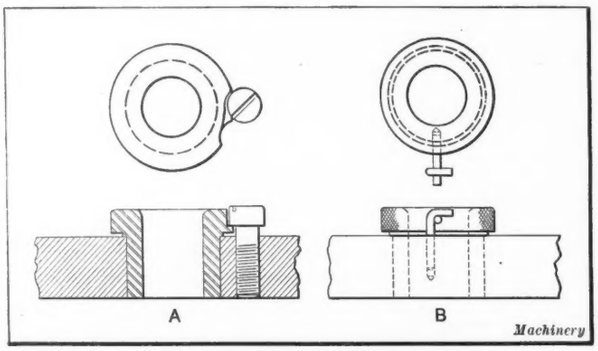
The following names for chain parts should be adopted: pin, instead of rivet or stud; bushing, the part in which the pin turns; roller, the part that turns over the bushing; side plate, instead of inside link or bushing side bar; pin-link plate, instead of outside link or rivet side bar; roller link, instead of center block; pin link, consisting of one pin-link plate assembled with two pins; connecting-link plate, the detachable pin link belonging to a connecting link; connecting link, a pin link and a connecting-link plate assembled; offset link, instead of cranked link, consisting of two offset side-plates assembled with a bushing and a roller at one end and an offset link pin at the other.

* * *

SLIP BUSHING WITH RETAINING DEVICE

BY HUGH H. LEE[1]

The lock for a drilling and reaming bushing shown at *A* in the accompanying illustration has been found by the writer to give general satisfaction among shop men. It is on the same principle as the one described in the March number of



Retaining Devices for Slip Bushings

MACHINERY, with the exception of the key. The bushing is machined in the same way, but a flat fillister-head cap-screw is used instead of the key and countersunk cap-screw, thus making it less complicated.

The lock shown at *B* consists of two pieces of 1/8- or 3/16-inch drill rod, as may be required. One of these pieces is left straight and is pressed into the side of the bushing; the other piece is bent at right angles and is pressed into the bushing plate, the bent part pointing in the opposite direction to that in which the drill or reamer will turn. The bushing is slipped into the hole and is given a twist toward the hook, the bend coming just high enough to catch the pin in the bushing. This holds the bushing from rotating or drawing out of the plate with the drill or reamer.

* * *

DEFINITION OF COMPRESSED-AIR TERMS

Upon the recommendation of its technical committee, the Compressed Air Society, 30 Church St., New York City, has adopted the following definitions of certain compressed-air terms and the society recommends that the use of other expressions of efficiency be discontinued:

Displacement—The displacement of an air compressor is the volume displaced by the net area of the compressor piston.

Capacity—The capacity is the actual amount of air compressed and delivered, expressed in free air at intake temperature and at the pressure of dry air at the suction; it should be expressed in cubic feet per minute.

Volumetric Efficiency—Volumetric efficiency is the ratio of the capacity to the displacement of the compressor.

Compression Efficiency—Compression efficiency is the ratio of the work required to compress isothermally all the air delivered by an air compressor to the work actually done within the compressor cylinder, as shown by the indicator cards, and may be expressed as the product of the volumetric efficiency, the intake pressure, and the hyperbolic logarithm of the ratio of compression, all divided by the indicated mean effective pressure within the air cylinder or cylinders.

Mechanical Efficiency—Mechanical efficiency is the ratio of the air indicated horsepower to the steam indicated horsepower in the case of a steam-driven machine, and to the brake horsepower in the case of a power-driven machine.

Over-all Efficiency—Over-all efficiency is the product of the compression efficiency and the mechanical efficiency.

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NEW MACHINERY AND TOOLS

THE COMPLETE MONTHLY RECORD OF NEW AMERICAN METAL-WORKING MACHINERY

Cleveland Milling Machine. Cleveland Milling Machine Co., Cleveland, Ohio..... 1147
Pannier Single-stroke Pneumatic Hammer. Pannier Bros. Stamp Co., Inc., 207-209 Sandusky St., Pittsburg, Pa.... 1148
Oliver Speed Lathe. Oliver Machinery Co., Grand Rapids, Mich. 1148
Turret for Dalton Six-inch Lathes. Dalton Mfg. Corporation, 1915 Park Ave., New York City..... 1149
Ohio Mill Type Lifting Magnet. Ohio Electric & Controller Co., 5900 Maurice Ave., Cleveland, Ohio..... 1149
Shaw Blueprint Wringer. Shaw Blueprint Machine Co., 9-11 Campbell St., Newark, N. J..... 1149
Crescent Electrical Industrial Truck. Crescent Truck Co., 347-349 First Ave., Elizabeth, N. J..... 1149
Coats Lead Testing Machine. Coats Machine Tool Co., Inc., 30 Church St., New York City..... 1150
Widney Resiliometer. Advance Felt Specialty & Cutting Co., 320 S. Jefferson St., Chicago, Ill..... 1150
Lewis Automatic Hoist for Furnace Doors. Link-Belt Co., 39th St. and Stewart Ave., Chicago, Ill..... 1151
Kane & Roach Circular Bending Machine. Kane & Roach, Niagara and Shonnard Sts., Syracuse, N. Y..... 1152
Persons-Arter Rotary Surface Grinder. Persons-Arter Machine Co., Worcester, Mass..... 1152
Kane & Roach Drill Rod Shears. Kane & Roach, Niagara and Shonnard Sts., Syracuse, N. Y..... 1152
Wisconsin Sensitive Radial Drilling Machine. Dauber-Kratsch Co., Oshkosh, Wis..... 1153
Hindman Shell Turning and Boring Lathes. Duff Mfg. Co., Pittsburg, Pa..... 1153
Fraser Self-contained Universal Grinder. Warren F. Fraser Co., Westboro, Mass..... 1154
Loshbough-Jordan Combination-geared Inclinable Press. Loshbough-Jordan Tool & Machine Co., Elkhart, Ind... 1155
Sheffield Lead Testing Machine. Sheffield Machine & Tool Co., Dayton, Ohio..... 1155
Stuebing Model K Lifting Truck. Stuebing Truck Co., Cincinnati, Ohio..... 1156
Koch & Sandidge Adjustable Cutter for Cutting Holes in Plates. Koch & Sandidge, 19 S. Wells St., Chicago, Ill.... 1156
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Leeds & Northrup Double Recorder for Heating Furnaces. Leeds & Northrup Co., 4901 Stenton Ave., Philadelphia, Pa..... 1157
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Thompson Universal Cutter and Tool Grinder. Thompson Grinder Co., Springfield, Ohio..... 1158
Elyria Heavy-duty Lathe. Elyria Machine Co., Elyria, Ohio.. 1158

CLEVELAND MILLING MACHINE

The important features of this machine are a square over-arm, a feed-box in the knee—thus eliminating a universally jointed feed-shaft—a column cast solid with the base, a single-pulley, constant-speed drive with sixteen changes of speed, exclusive use of sliding gears, hardened and ground gears and shafts, bronze bearings throughout, and a supporting post for the knee with a one-piece elevating screw.

A MILLING machine embodying several unusual and interesting features, and one which differs somewhat in its general appearance from the more conventional designs, has been brought out by the Cleveland Milling Machine Co., Cleveland, Ohio. This machine has a single-pulley, constant-speed type of drive, with sixteen changes of spindle speed and sixteen changes of feed. These speeds and feeds are controlled by two levers of the ball joint type, similar to the levers of automobile gear shifts. These levers may be seen projecting from the side of the column in Fig. 1. All changes of speed and feed are obtained through sliding gears, and they are in geometrical ratio. The feed-box is in the knee, so that a universally jointed feed-shaft is not required.

The power transmission is so arranged that no loose gears are required on the spindle. All the shifting of gears is done on secondary shafts below the spindle. Tumbler gearing has been eliminated entirely both in the main drive and in the feed mechanism. The spindle reverse is contained within the machine, so that right- or left-hand cutters may be used. All of the speed, feed, and other driving mechanism is self-contained within the machine, none of the driving mechanism being bolted on the outside of the column or knee. All the gears and shafts in the driving and feeding mechanism are of hardened steel, are automatically lubricated, and run in bronze bearings.

The machine column is a complete box section of very rigid construction. The base and column are cast in one piece. This is a semi-steel casting, heavily ribbed, and tied together with heavy vertical and horizontal walls. The only openings in the column are those necessary for the change-gear levers on the front, the pulley drive housing in the rear, and the cutter lubricant tank on the left side of the machine. Access to the inside of the column is not necessary, as all interior parts are automatically lubricated and all bearing adjustments are made from the outside. Horizontal and vertical walls separate the lubricating oil for the machine from the cooling compound used on the cutter, and also serve to make the column more rigid. The base of the machine is finished on the under side so that it will stand evenly and solidly on its foundation. The base is pan shaped and has enough depth to catch oil and chips. The dovetail knee slide extends up to the over-arm, thus providing ample surface for clamping attachments. This dovetail slide is so arranged that the heaviest pressure is not taken at the thinnest section of the wall.

The knee, as well as the column, has an improved dovetail slide. The bearing of the saddle is not on the thinnest section of the slide, but on the wide, flat surface, the narrow slide acting as a guide only. There is no bearing in the center of the dovetail slide, which eliminates the chances of its being marred by wrenches or other tools which may be laid on top of the knee. The bearing of the knee on the column is extended well above the top of the saddle slide, thus giving the knee a longer bearing on the column and reducing the bearing pressure to a minimum. The feed-box, as well as the knee, is entirely enclosed, thus excluding any chips from getting into the feed mechanism. The elevating screw is large in diameter and in one piece. The knee is supported on a post which acts both as a support to the elevating nut and as a guide in the knee. The hand feed and power feed for the knee are independent of each other.

The table of the machine is finished all over, so that it will not be likely to warp on ac count of internal strains. Th

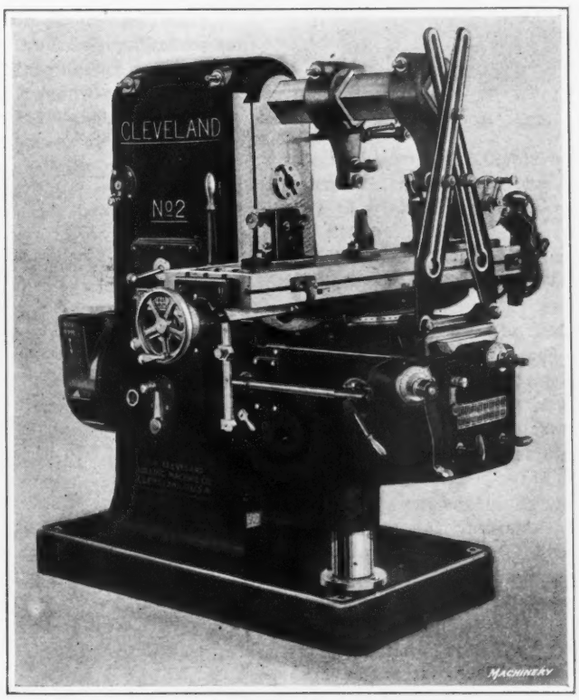


Fig. 1. Cleveland No. 2 Milling Machine

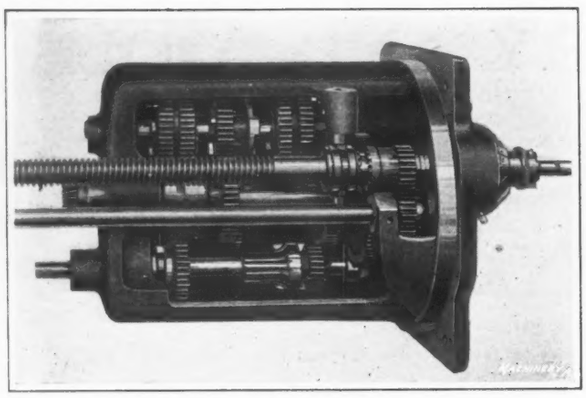


Fig. 2. Detail View of Feed Mechanism which is enclosed in Knee

bearings on the table are at the top of the saddle, instead of at the bottom of the dovetail. This method secures a large bearing surface and locates the bearings at greater distances apart. These bearings are automatically lubricated by rollers in the saddle. The bearing on the saddle is also at its widest portion, and both the saddle and table bearings are provided with long taper gibs and adjusting screws to compensate for wear.

One of the unusual features of this machine is the square over-arm. This form was adopted to provide a positive alignment of the arbors and a maximum rigidity of the arm pendants. If the arbor is not true and the arm pendant or support is adjusted by the operator to accommodate the arbor, the latter, under these conditions, will work in a cramped position, which tends to produce crystallization and breakage. With the square over-arm, it is impossible for the operator to place the arbor supports on the over-arm and arbor in any other way than exactly in line.

The spindle is flanged, which eliminates the overhang on the end of the spindle and the trouble caused by cutters screwing

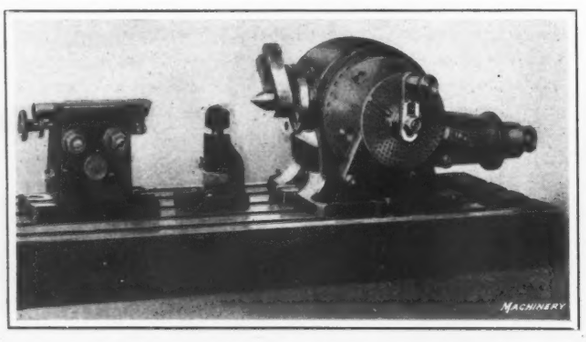


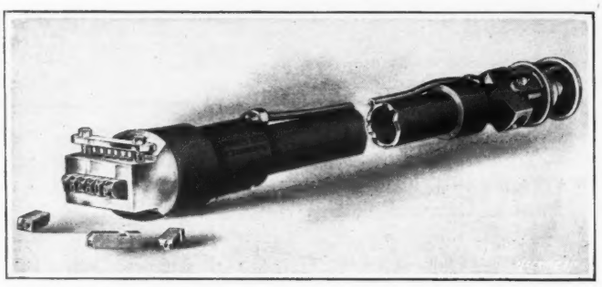
Fig. 3. Dividing Head of Cleveland Milling Machine

fast on the spindle. The flanged spindle has a face keyway into which are inserted hardened steel jaws for driving arbors or face mills. It is not necessary to remove these jaws when changing from a face mill to an arbor. The spindle is provided with a positive lock that enables the operator to loosen the arbor nuts readily. A handwheel is also provided for revolving the spindle which is convenient for the operator. The spindle lock cannot be operated while the machine is running, nor can the main driving clutch be engaged while the spindle lock is in the locking position. The bearings at the front and rear ends of the spindle are adjusted with a nut on the outside at the rear end of the spindle.

All bearings and gears in the column and knee are flooded with lubricant, so that oil-holes in these members are unnecessary, and the operator does not need to oil the important parts of the machine. The reservoir containing the oil requires filling only once in several months. A sight glass on the side of the column shows the condition of the oil supply at all times. The machine has a centrifugal pump for supplying cooling compound to the cutters. This pump operates only when the spindle is revolving, so that it is not necessary to shut off the cooling compound when changing the work or measuring it, the control being entirely automatic.

PANNIER SINGLE-STROKE PNEUMATIC HAMMER

A single-stroke pneumatic hammer intended especially for stamping purposes is now being manufactured by Pannier Bros. Stamp Co., Inc., 207-209 Sandusky St., Pittsburg, Pa. This hammer may be used for either hot or cold stamping. The head used for hot stamping contains a series of wheels on which the figures are engraved, so that by turning the wheels any desired combination of figures can be obtained. For cold stamping, a head holding single numeral stamps is used. The hammer is connected by hose to any air line, and it is used by simply placing the stamping head against the part to be marked and opening the valve in the handle. The plunger is then driven against the stamping head, which produces a clear impression on the work. The hammer weighs about 18 pounds and requires about 80 pounds air pressure. This hammer is the result of a suggestion made by a prominent superintendent of one of the big Pittsburg steel mills,

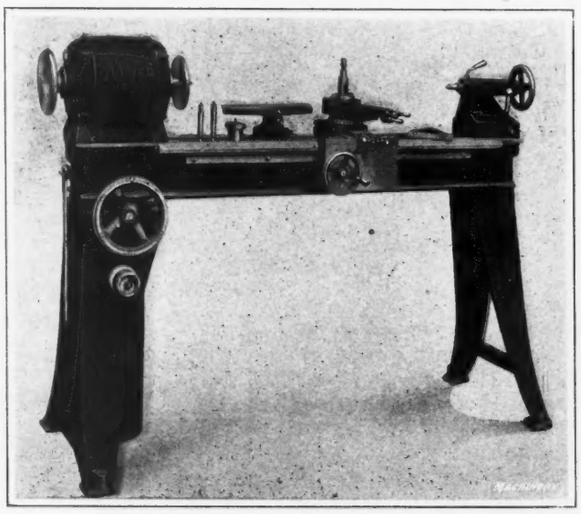


Pannier Single-stroke Pneumatic Hammer made especially for Stamping Purposes

who required a device of this kind. The hammer is intended for stamping heat, slab, or serial numbers on steel billets, rods, bars, flats, and other heavy metal products.

OLIVER SPEED LATHE

The No. 51 speed lathe now being manufactured by the Oliver Machinery Co., Grand Rapids, Mich., is driven by a motor designed for three-phase alternating current of 60 cycles and 220 volts. The illustration shows a machine equipped with a hand-feeding carriage and a compound swivel rest, but the lathe may be provided with a plain bed in 4- or 5-foot lengths, with capacities between the centers of 24 and 36 inches, respectively. The swing of this lathe is 12 inches. The motor, headstock, and ball bearings are entirely enclosed, thus excluding dust and dirt. The rear end of the motor is fitted with a combined handwheel and faceplate. This is a new feature for which a patent has been applied. The periphery of the faceplate is rounded the same as a handwheel and the inside face is curved inward, thus forming a rim which



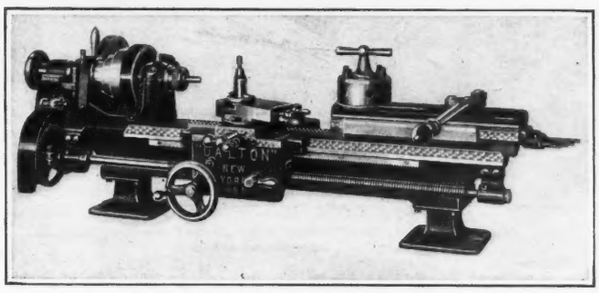
Oliver No. 51 Speed Lathe driven by Three-phase Alternating-current Motor

can readily be gripped. The outer surface, however, is straight or flat and forms a faceplate for rear end turning.

The controller of the motor is dustproof and similar to a street car controller, although very much smaller. It is mounted inside of the left-hand leg and is operated by the handwheel seen at the front. The rim of this handwheel is marked to indicate the "off position" and the different speeds which are 570, 1140, 1725, and 3450 revolutions per minute. The mark at the top indicates the motor speed and the mechanism is such that the handwheel cannot be turned in the wrong direction. All parts of the lathe are interchangeable.

TURRET FOR DALTON SIX-INCH LATHES

A turret designed for application to the six-inch bench lathes of the Dalton Mfg. Corporation, 1915 Park Ave., New York City, is shown on the lathe here illustrated. This turret has six holes or tool positions, and its slide is operated by the horizontal hand-lever seen in the illustration. Individual stops

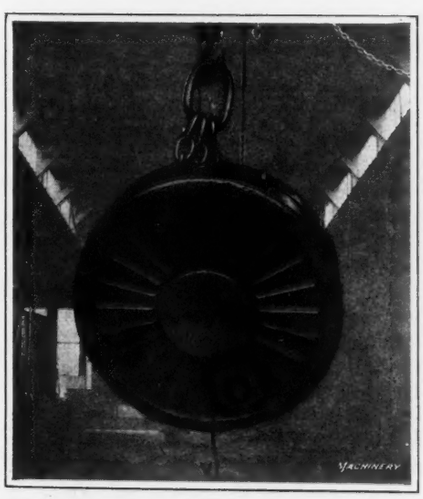


Dalton Six-inch Lathe equipped with Turret

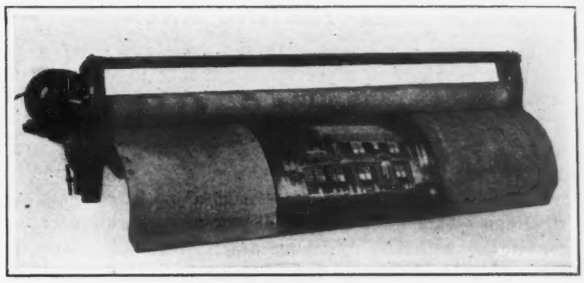
are provided for each turret hole. When the turret-slide is being turned, the turret automatically indexes for locating the next successive tool in the working position. This turret attachment is especially adapted for manufacturing operations on duplicate parts which must be held in the chuck.

OHIO MILL TYPE LIFTING MAGNET

The Ohio Electric & Controller Co., 5900 Maurice Ave., Cleveland, Ohio, is the manufacturer of the 50-inch, or No. 5, mill type lifting magnet shown in the illustration which is a view of the bottom surface. The design of this magnet conforms in general to accepted standards which have proved to be most efficient and it possesses several detail features designed to eliminate the most common causes or sources of operating trouble. Possibly the most serious and expensive troubles have been due to grounds and to open ends and short circuits resulting from the loosening of the internal screw and nut connections by the severe vibration and jolts to which magnets are subjected. In order to avoid difficulties of this kind, welded connections and asbestos insulation are used exclusively in the Ohio magnets. To prevent the breakage of the bolts and the outer rings, the magnet, which is over eight inches high, is secured by heavy chrome-vanadium steel studs having nuts on the top of the case protected by ribs. Other improvements are: minimum of head room, ample copper in the coil, heat radiating ribs at top and bottom, and flexible armored leads welded directly to coil.



Ohio Fifty-inch Mill Type Lifting Magnet



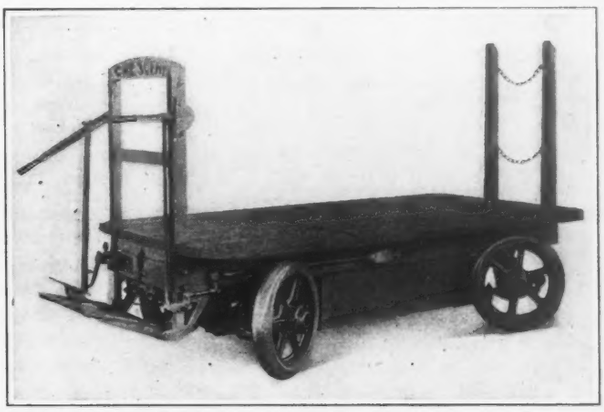
Shaw Blueprint Wringer

SHAW BLUEPRINT WRINGER

The blueprint wringer which has just been brought out by the Shaw Blueprint Machine Co., 9-11 Campbell St., Newark, N. J., is driven by an electric motor through worm-gearing and handles blueprints at the rate of ten linear feet per minute. This wringer is fastened directly to the washing tank, and the prints may be fed through it without lifting them from the bath. It is claimed that this wringer will remove over 90 per cent of the water, and as the prints emerge from it they are dry enough to trim and use within four minutes. The prints after passing through the wringer are also free from wrinkles. This wringer is designed to take the place of expensive drying machines.

CRESCENT ELECTRICAL INDUSTRIAL TRUCK

The electrically driven industrial truck made by the Crescent Truck Co., 347-349 First Ave., Elizabeth, N. J., and designated as the Type F, has a rated capacity of 4000 pounds and will run without recharging at a speed of from five to seven miles per hour during a ten-hour day and with the full working load. One of the interesting features of this truck is



Crescent Four-wheel Steer Electric Industrial Truck

the method of steering. The steering lever, which is operated vertically, is directly connected to all four wheels. By turning all four wheels for steering, a very short turning radius is obtained. In fact, this truck has a turning radius of six feet, measured from the center line, so that it will enter the side door of a standard box car and run toward either end. The truck wheels are driven through a worm-gear type of differential and the whole driving mechanism is enclosed in a housing, as shown in the illustration, and continually runs in oil.

The truck platform is 23 inches above the floor and is 48 inches wide and 7 feet 6 inches long. This platform is hinged to allow access to the driving mechanism and battery. The controller is of the drum type, there being three speeds forward and three reverses, with a positive stop between. The frame is made up of 4-inch channel steel. The wheels are cast steel and have solid rubber tires 20 inches in diameter. These wheels are provided with Timken roller bearings. The wheel-base of the truck is 4 feet 10 inches, and the tread 36 inches. The length over-all is 9 feet 3 inches.

COATS LEAD TESTING MACHINE

For use in testing the lead of thread gages and other work where it is required to make measurements to 0.0001 inch, the Coats Machine Tool Co., Inc., 30 Church St., New York City, has recently placed on the market a machine on which the necessary mechanism is furnished to operate a Prestwich fluid gage, by means of which readings of the magnitude of error in lead are obtained. Reference to the accompanying illustrations, which show front and rear views of the machine, in connection with the following description, will make its operation quite clear. The thread gage to be tested is supported between centers and a stylus *A* is entered into the thread. This stylus is supported on a bellcrank pivoted at *B*, and six different sized points are furnished with each machine to provide for measuring threaded work of various pitches. The arms of this bellcrank are of equal length.

Any lateral movement of the stylus which enters the thread on the work, due to an inaccuracy in the lead of the thread, results in transmitting a vertical movement of equal magnitude to the horizontal arm of the bellcrank which engages the contact point on the Prestwich fluid gage diaphragm. In this way a reading is obtained of the magnitude of error in the lead. This will be clearly understood after reading the following description of the machine and the way in which it is used. It will be seen that the brackets which support centers on which the work is carried are mounted on the bed of the machine in such a way that their position may be adjusted to provide for handling work of various lengths. The remainder of the mechanism is supported on a vertical column, which is pivoted on a bar *C* at the back of the machine so that the point of stylus *A* is always held in contact with the work by gravity. Bar *C* is a sliding fit in brackets *D* and *E*, so that spring *F* may hold the ball point at the opposite end of bar *C* in contact with a fixed stop carried by bracket *G*.

In using the machine the thread gage is set up as shown, and the stylus point is entered into one of the threads, after which a careful reading is taken of the position where the fluid column in the Prestwich gage comes to rest. After this has been done, a Johansson block, having a thickness corresponding to any even multiple of the lead of the thread, is placed between the ball point at the end of bar *C* and the fixed stop carried by bracket *G*, and the stylus is again allowed to drop into place in the thread groove. If the lead is exactly uniform, the stylus will come to rest at the bottom of the thread groove—or if a stylus with a ball point is used, this point will bear uniformly on both sides of the groove—so that the reading of the Prestwich fluid gage will be the same as it was for the original setting.

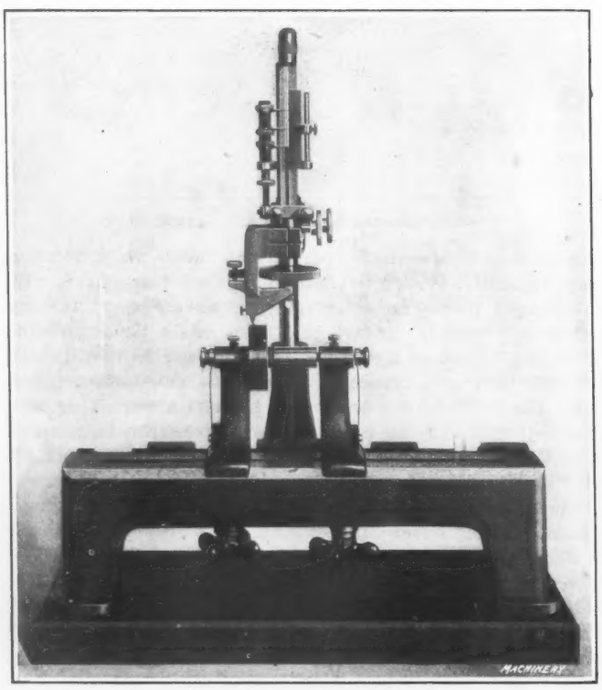


Fig. 1. Machine developed by the Coats Machine Tool Co., Inc., for testing Lead of Threads on Thread Gages, etc., to 0.0001 Inch

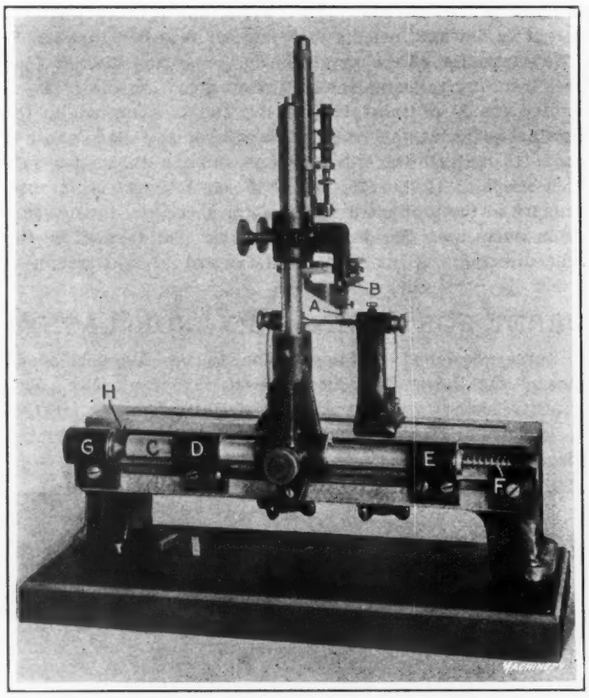
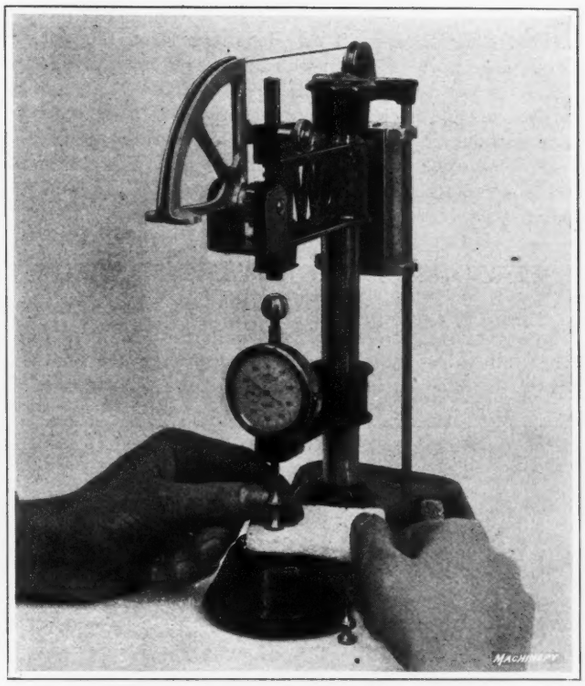


Fig. 2. Opposite Side of Coats Thread Lead Testing Machine, showing how Johansson Gage-blocks are used

Should it happen that the lead is short, the stylus will first engage the thread at the right-hand side, and in sliding to a position at the bottom of the thread groove, it will cause the lower arm of the bellcrank to swing slightly toward the left. This means that the horizontal arm of the bellcrank will be raised an equal amount and cause the level of the column of liquid in the fluid gage to rise, the error in lead being read on the scale as the difference between the reading for the original setting and the reading after the Johansson block has been inserted. Conversely, if the lead is long, the stylus will engage the thread at the left-hand side and cause the lower end of the bellcrank to be pushed to the right, thus lowering the horizontal arm and allowing the column of liquid in the fluid gage to fall. The error in lead under such conditions is, of course, the difference between the readings of the fluid gage for the original and final settings, as in the case of a thread with a short lead. It is considered good practice to use a thin Johansson block between the ball point and stop, as shown at *H* in Fig. 2, before making the original setting, and for the second setting this block and a Johansson block representing some multiple of the lead are both inserted. This is felt to be the means of securing more absolute uniformity in results, although it has no theoretical significance in the operation of the machine.

WIDNEY RESILIOMETER

The "resiliometer" is an instrument for testing the thickness, hardness, and resiliency or "life" of any resilient materials such as are used for washers, packing, gaskets, shock absorbers, etc. The tests made with this instrument may be used as a guide in the purchase of mechanical felt, rubber, and similar materials. The accompanying illustration shows the instrument being used to ascertain the thickness of material. The thickness of this particular sample is 0.283 inch, which is the normal or natural thickness. The large dial of the gage is graduated to thousandths of an inch, and one revolution of the large pointer is equivalent to one-tenth inch. If the material is more than one-tenth inch thick, thus causing the indicator hand to make more than one complete revolution around the dial, the reading is indicated by first noting the position of the indicating hand of the small dial, which is inside the face of the larger one.



"Resiliometer" for testing Thickness, Hardness, and Resiliency or "Life" of All Resilient Materials

In order to ascertain the degree of hardness of the material, a spring catch is released which holds the weight suspended at the rear of the instrument, thus allowing the quadrant to which the weight is attached by a wire to swing back until the presser-foot of the dial gage is subjected to pressure due to the weight. This presser-foot then sinks into the material, thus reducing the thickness at this point as indicated by a backward movement of the indicating hand of the dial gage. This reading is then compared with the normal or original reading. For instance, if the normal thickness were 0.283 inch and the thickness under pressure 0.111 inch, this would indicate that the material was 39.2 per cent hard, according to the Widney standard. If the material were not compressed at all, this hardness would be 100 per cent—an impossibility with any resilient material.

The resiliency of any compressible material, such as felt, rubber, etc., is indicated by its capacity to recover from compression. To make the resiliency test, the quadrant is pulled back, thus releasing the pressure on the presser-foot. As soon as the weight and pressure are released, the hand of the dial gage again moves forward and the reading should be taken immediately in order to ascertain the "instant resiliency" and not the gradual return to the normal thickness. If the reading under pressure were 0.111, as previously mentioned, and the thickness reading 0.200 as soon as the pressure was released, the rebound or resiliency would be equivalent to 0.089 inch (0.200 — 0.111 = 0.089 inch), which is 51.7 per cent of the possible rebound.

The hardness and resiliency readings vary with the thickness of the material; the greater the thickness, the greater the resistance to penetration, so that a higher hardness reading is obtained. The resiliency reading also increases at a ratio of approximately one-half the increase in the hardness reading. The resiliometer is manufactured by the Advance Felt Specialty & Cutting Co., 320 S. Jefferson St., Chicago, Ill.

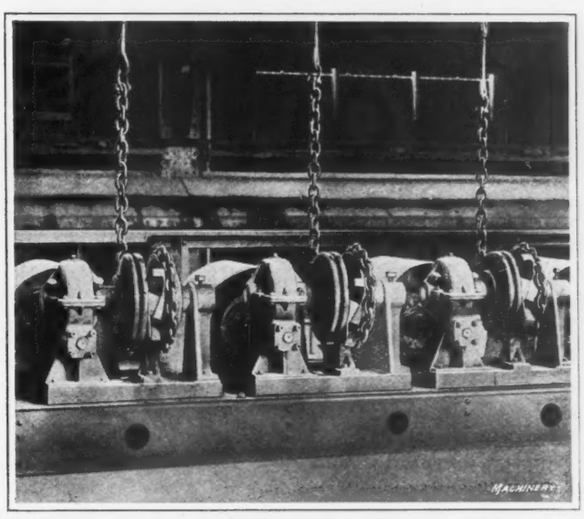
LEWIS AUTOMATIC HOIST FOR FURNACE DOORS

The operation of the heavy doors of open-hearth furnaces and of certain other large furnaces used for the heat-treatment of metal products is usually effected by some form of hydraulically operated mechanism. The hoisting mechanism shown in the illustration, which is manufactured by the Link-Belt Co., 39th St. and Stewart Ave., Chicago, Ill., is an electrically driven automatic-releasing type. This hoisting mechanism was designed at the plant of the Alan Wood, Iron & Steel Co., Conshohocken, Pa., where it has been used continuously for over a year without repairs, attention, or maintenance expense.

Three of the hoists are shown in the illustration. Each one is provided with a pair of chain sheaves, mounted loose on a worm-wheel shaft between two flanges which are pinned to the shaft and supplied with fiber friction surfaces on the sides toward the sheaves. The worm-wheel is driven by a worm mounted on the shaft of a reversible motor, the worm and wheel being enclosed in a suitable housing. To the left-hand sheave is attached a chain which leads up to the tackle for raising the furnace door, and to the right-hand sheave is fastened a chain from which is suspended a heavy counterweight (down behind the mechanism shown). The wrap of the chains around the sheaves is in opposite directions. The contact surfaces between the sheaves have a beveled or spiral shape, with the result that when both chains are under tension, the sheaves are squeezed tightly against the friction flanges at the sides, and thus compelled to rotate in the direction of motion of the worm-wheel shaft.

To raise the furnace door, the motor is started in the direction which will pull down on the left-hand chain. As long as the counterweight continues its pull, the sheaves squeeze out against the flanges, and are thereby driven in the direction which will wind up the left-hand chain, and thus lift the door. The right-hand sheave has a fixed stop on its periphery, so located that it will come in contact with a stop on the bottom casting when the furnace door has reached its proper height. With the motion of the right-hand sheave arrested by this stop, the shaft cannot rotate the left-hand sheave further, because the squeeze between the sheaves and friction flanges is relieved. There is no opportunity, therefore, for over-winding, and if through carelessness the current is not shut off promptly, the shaft with its flanges will simply continue to revolve in sliding frictional contact with the sheaves, but without power to grip and rotate them further.

For lowering the doors, the direction of the motor is reversed, and practically the same process repeated, except that in this case the power of the motor is used to lift the counterweight, while the pull from the weight of the door serves to keep the sheaves squeezed apart against the friction flanges, until a stop on the left-hand sheave engages with a stop on the bottom casting, and prevents over-winding of the counterweight chain in the same manner as described for the other sheave. In other words, the door always goes up to the proper position, and always comes down to the proper position, no matter what its weight may be. Even if the door were considerably heavier than the counterweight, there would be no danger of its descending and pulling the counterweight up when the motor is stopped, for the instant the counterweight sheave is started toward reversal, the pull of its chain would squeeze the sheaves apart against the friction flanges,



Lewis Motor-driven Automatic-releasing Hoists for Heavy Furnace Doors

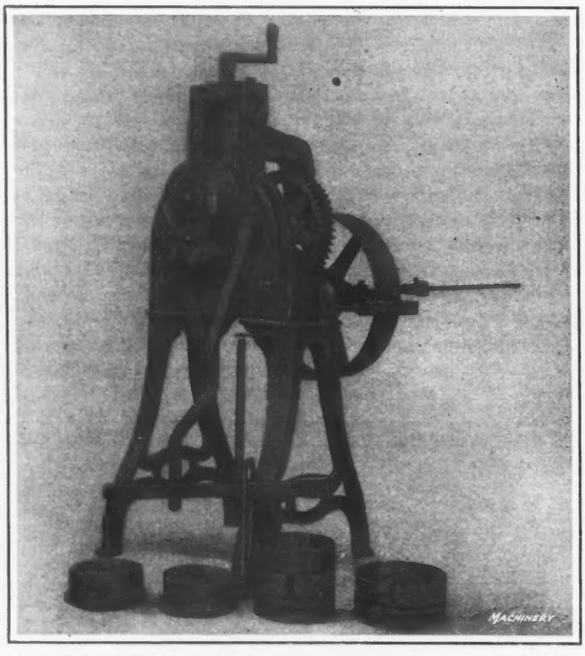
and the two sheaves would thus be put completely under control of the worm-wheel shaft again, and the worm-wheel is, of course, locked in position by the worm. The motor is started, stopped, or reversed by simple push-button mechanism. In the case of skip hoists, the sheaves are replaced by drums.

KANE & ROACH CIRCULAR BENDING MACHINE

The bending machine to be described is designed to bend material to a true circle without leaving flat or straight sections at the adjoining ends. In order to obtain this result, the upper roll around which the stock is bent (see accompanying illustration) is adjustable vertically and is also changeable so that the machine may be equipped with a roll corresponding to the diameter of the parts to be bent. The material that requires bending must be tightly gripped between this upper roll and the two lower rolls so that the stock is rolled tightly around the upper roll, thus forming a true circle.

The shaft which carries the upper roll is mounted in a sliding head, and vertical adjustment is obtained by a screw connecting with a crank at the upper part of the machine. The two lower rolls are mounted in an eccentric sleeve which provides vertical adjustment for tightening or releasing these rolls with respect to the band being bent. When the foot of the operator is removed from the lever, the arms of the eccentric sleeve rise and the corrugated rolls move down away from the work and release it. The work can then readily be removed while the machine is running. The two lower rolls are made of steel and are hardened. The corrugations on these rolls serve to pull the material through without slipping, but they do not mar or injure the material.

In order to obtain a true circle, free from any flat or straight sections on the ends, the upper roll should be about 1/4 inch smaller in diameter than the inside diameter of the work. If it is necessary to have extra stock in order to allow for welding the ends together, the roll should either be the same



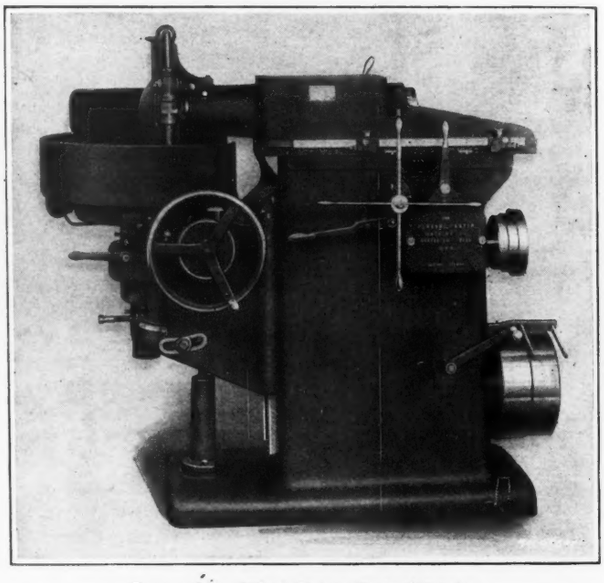
Kane & Roach Machine designed to bend to a True Circle without leaving Flats or Straight Sections at Ends

diameter as required for the work or from 1/8 to 3/16 inch larger to allow for the lap without having the ends overlap on the roll itself. The diameter of the upper roll may be varied as required by the work, so long as it is within the range of the machine.

In operating this machine, the foot-lever is depressed, thus moving the corrugated rolls up to the working position, as determined by a suitable stop. The space between these rolls and the upper one should be so regulated that the material is gripped tightly as it passes between the rolls during the bending operation. As soon as the bend is completed, the foot-lever is released, as previously mentioned, and the work removed. The work can be inserted, finished, and removed rapidly and while the machine is in operation. The gears are machine-cut, and a clutch pulley is provided for starting and stopping the machine. Machines of this general type are made in different sizes, depending upon the nature of the work. They are manufactured by Kane & Roach, Niagara and Shonnard Sts., Syracuse, N. Y.

PERSONS-ARTER ROTARY SURFACE GRINDER

The rotary surface grinder shown in the illustration is a 16-inch size now being manufactured by the Persons-Arter Machine Co., Worcester, Mass. This machine is designed along



Persons-Arter 16-inch Rotary Surface Grinder

the same general lines as the 8- and 12-inch sizes made by this company, but it is of heavier construction and has some new features, including a different oiling system, different clutches, increased grinding angle capacity, and a special design of water pan and brackets. While the 16-inch model is equipped with a magnetic chuck 16 inches in diameter, it has a capacity for work up to 17½ inches in diameter and can swing work 21 inches in diameter with the wet equipment and 24 inches in diameter with the dry grinding equipment. Rectangular work up to a limit of 8 or 16 inches may be ground.

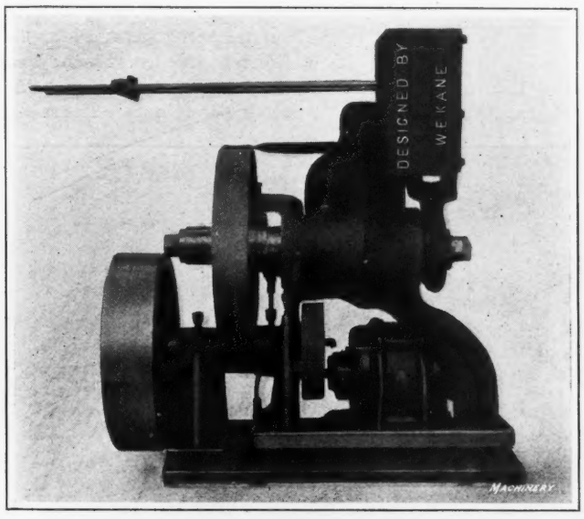
The vertical capacity of the work-table is 10 inches when using a full diameter grinding wheel. The entire chuck spindle bracket is pivoted on a taper pin, so that it can be tilted forward or backward for grinding beveled surfaces up to an angle of 16½ degrees. The bracket is adjusted by a screw which indicates the angle of the adjustment. Special attention has been given to the design of the water pan and also to the protection of the chuck and its electrical connections. All wiring is contained in the water pan, and the magnetizing of the chuck is controlled by an extra-heavy, double-pole switch which has a quick-action demagnetizing feature. These rotary surface grinders are used for grinding piston rings, cutters, circular saws, bearing races, valves, disks, dies, gages, etc.

KANE & ROACH DRILL ROD SHEARS

Kane & Roach, Niagara and Shonnard Sts., Syracuse, N. Y., are now manufacturing shears designed especially for cutting off high-speed steel drill rods or any small round bars that need to be cut accurately, particularly if it is essential to obtain a clean, square cut without marring or distorting the bar of stock. These special machines are made in two sizes. The No. 2 size is capable of shearing material varying from about needle size up to and including 1/2 inch. The dies are

made so that a separate hole for each size may be provided. These holes in the dies fit each size rod or bar very closely. One set of dies may have from twelve to fifteen holes, the number depending upon the size stock to be cut. The stationary and sliding shear blades are duplicates. The holes in each blade are in alignment and provision is made for vertical or lengthwise adjustment to maintain the alignment. There is an eccentric in the connecting-rod on the crank end, so that adjustment may be obtained without interfering with the travel or stroke.

The bearings in both ends of the connecting-rod are bronze and all the gears are machine cut. The bearings for the balance wheel and pinion shaft are also of bronze, and the motor is mounted directly on the base, as the illustration shows. The starting or stopping of the machine is controlled by the foot-treadle which extends around the bottom of the machine. An



Kane & Roach Shears designed especially for cutting Steel Rods

adjustable stop-gage is provided to regulate the lengths cut off. These machines are usually placed beneath a table and are enclosed or covered, with the exception of the top or shearing part and the sliding gage. The machine is thus protected from dust and the operator is safeguarded.

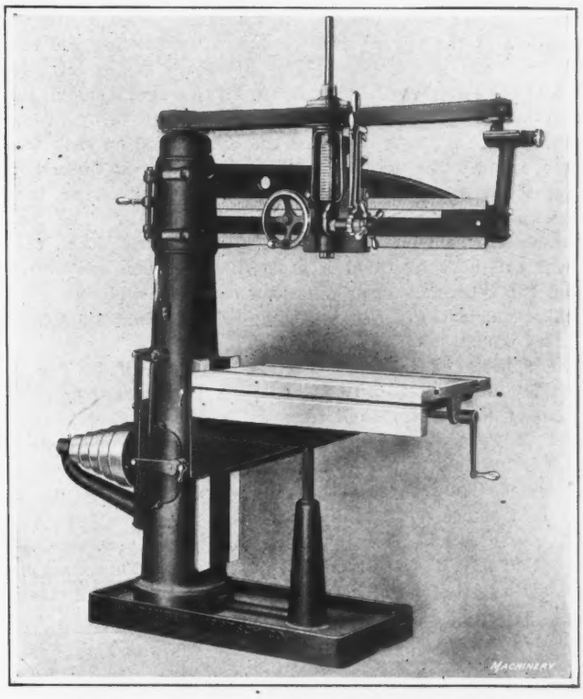
The No. 3 size is designed for diameters up to and including 3/4-inch round stock. While it can be used for very small stock, it is usually employed for sizes down to about 1/2 inch, which represents approximately the maximum capacity of the No. 2 machine. The No. 3 machine is arranged for a separate set of dies for each size of stock. The design and construction of the No. 3 machine are practically the same as the No. 2, except that it is much larger and designed for heavier work. These machines are especially adapted for use in tool steel plants, particularly where carbon or high-speed steel drill rods are manufactured. They are also useful for cutting round bars for other purposes, especially if the material is tool steel. These shears may also be used for cutting cold-rolled stock or other material when an accurate square end is desirable. A motor drive is recommended, but the machines can be arranged for a belt drive if desired.

WISCONSIN SENSITIVE RADIAL DRILLING MACHINE

The high-speed sensitive radial drilling machine recently put on the market by the Dauber-Kratsch Co., Oshkosh, Wis., is shown in the illustration. This machine has a rigid hollow column bolted to the base casting. The table is carried on wide vees, giving a substantial bearing on the column to which the table is gibbed. Additional support is obtained from the screw beneath the table, and vertical adjustments are made by turning the crank handle seen at the front of the machine. This crank operates the elevating screw through a pair of beveled gears. The load of the table and work is taken by a ball thrust bearing, so that vertical adjustments may easily be made. The radial arm is a hollow section and ribbed to take care of both torsional and bending stresses. This arm may be locked in position by means of one clamping screw, which locks both the top and bottom of the arm by operating eccentric clamps. The drill head is adjusted along the arm by the handwheel at the left of the spindle in conjunction with a rack and pinion. A single locking lever is used for locking the head in position.

The distance from the face of the arm to the center of the spindle is only 1⅝ inch, so that torsional stresses in the arm are relatively small. A hand-lever is used for feeding the spindle. This feed-lever is connected to the spindle through a ratchet, which is disengaged when the lever is thrown back to a vertical position, so that the spindle may be moved downward by the handwheel located at the right of the spindle. This handwheel may also be used for feeding very small drills. The drive for the machine is through a pair of rawhide and steel bevel gears to a central shaft inside the column. The pulley mounted on the upper end of this shaft drives the drill spindle by the belt shown in the illustration. The outer end of the arm carries a belt tightener to maintain the proper tension at all times. The tapping attachment is located in the column and is operated by the hand-lever at the front of the column, which controls a friction clutch and may be used for starting or stopping the machine as well as for reversing the drill spindle. All the principal bearings have double-row self-aligning S K F ball bearings. These machines may be provided with a T-slotted base and a table that may easily be swung out of the way. They are also made with either belt or motor drive.

The spindle speeds vary from 250 to 1200 revolutions per minute; ¾-inch high-speed drills may be used, and the machine drills to the center of a 72-inch circle; the working sur-



Wisconsin High-speed Sensitive Radial Drilling Machine

face of the table top is 20 by 33 inches; the working surface of the table at the side is 5 by 33 inches; the vertical movement of the table is 16½ inches; the vertical movement of the spindle is 8 inches; the traverse of the head on the arm is 34 inches; and the weight is 1825 pounds.

HINDMAN SHELL TURNING AND BORING LATHES

The Duff Mfg. Co., Pittsburg, Pa., has recently brought out two high-duty lathes especially designed for turning and boring shells. The turning lathe is illustrated in Fig. 1 and the boring lathe in Fig. 2. These lathes are particularly adapted for machining 155-millimeter and 6-inch shells. Both the turn-

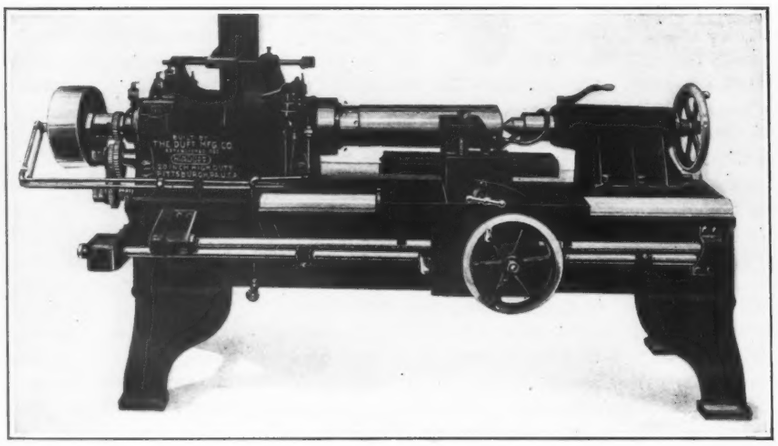


Fig. 1. Hindman Shell Turning Lathe

ing and boring lathes swing 20 inches over the ways. The drive is from a 5-inch belt. The loose pulley to which the belt is shifted when the machine is idle is mounted on roller bearings and is slightly smaller in diameter than the tight pulley to relieve the strain on the shaft. The thrust of the headstock spindle is taken at the rear by means of large self-aligning ball bearings. As these are "single-purpose" machines, one spindle speed of any ratio desired is provided. The speed ratios available are 11 to 1, 14¼ to 1, 18¼ to 1, and 25.3 to 1.

The apron of the lathe is of very simple construction and contains only two gears which control the hand operation of the carriage in both directions. Quick-return of the carriage is obtained by throwing the operating lever (located at the extreme left of the apron) into reverse after shifting the belt from the tight to the loose pulley by means of the lever located at the top of the headstock. With this arrangement, the main spindle is at rest while the quick-return is operating. Automatic stops are provided on the control rod on each side of the apron. The feeding movement is derived through a center screw drive instead of the rack and pinion type, thus increasing the power and evenness of the pull. The feed regularly furnished is 0.125 inch, although any other feed desired can be substituted if ordered. The ways are of the round bar type, and when worn can easily be replaced. The machine illustrated in Fig. 1 is equipped with a pneumatically operated chuck.

The spindle of the shell boring lathe shown in Fig. 2 has a 7½-inch hole 25 7/16 inches deep, thus permitting 155-millimeter and 6-inch shell forgings in the rough to be inserted for practically their full length. This construction makes it possible to use a shorter bed, eliminates the use of "pot chucks" and permits the rough-boring operation to be performed before the rough-turning operation if desired. The front of the spindle is so designed that large set-screws can be used to hold the shell instead of a chuck. This machine has a six-way turret which is equipped with a powerful clamp extending over the entire surface of the turret base in order to hold the turret against play under the heaviest cuts. A rapid forward and backward traversing movement is provided. This lathe can be modified to take a saddle arranged for a single boring-bar controlled by a former or it can be equipped with a tailstock boring-bar and a power feed to the tailstock.

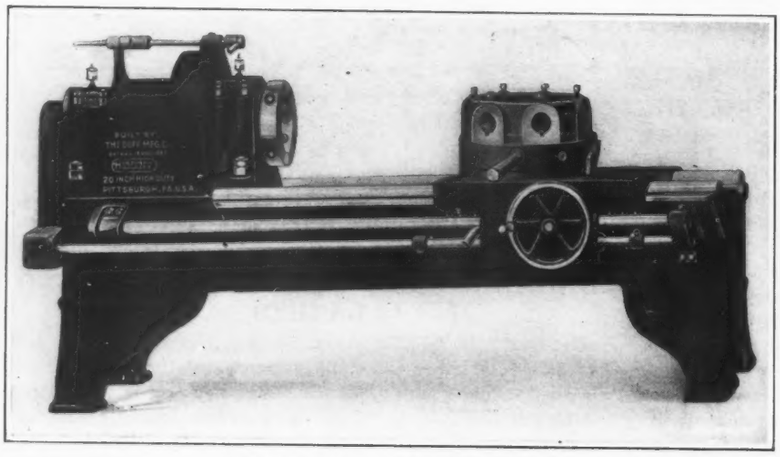
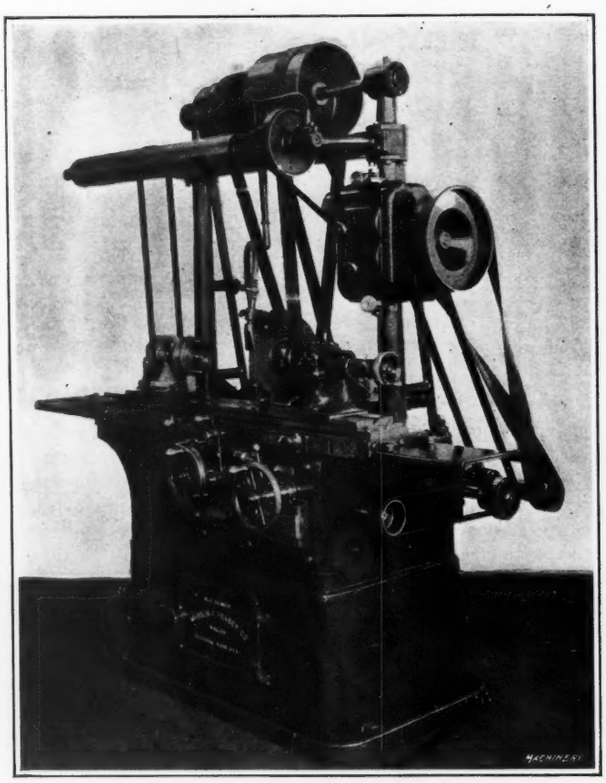


Fig. 2. Hindman Shell Boring Lathe

FRASER SELF-CONTAINED UNIVERSAL GRINDER

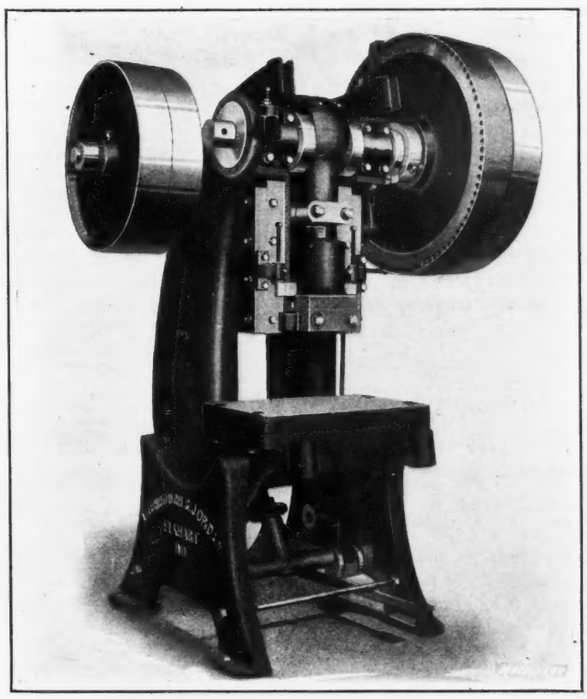
The high-power self-contained universal grinding machine manufactured by Warren F. Fraser Co., Westboro, Mass., which is shown in the accompanying illustration, is built in the four following sizes: 10- by 30-inch; 12- by 30-inch; 10- by 42-inch; and 12- by 42-inch. This machine has twelve changes of table speed, ranging from 12 to 235 inches per minute. There are also twelve spindle or work rotation speeds, varying from 14 to 279 revolutions per minute. These speed changes are obtained by means of a quick-change gearbox. Three grinding wheel speeds are provided. The countershaft is equipped with roller bearings and runs at 900 revolutions per minute. The machine is adapted for a direct drive from the lineshaft or motor. The Fraser automatic reversing movement, for which patents have been allowed, is used. This movement gives a slow traverse to the table at the end of the stroke, and brings the table to rest before the clutch is shifted for driving in the reverse direction. This reverse movement is employed to make the grinder operate smoothly and permit employing the highest rates of table traverse without shock or jar. These features are of particular value in a machine of this kind, and enable the machine to meet the requirements for which it has been designed.



Fraser Self-contained Universal Grinder

LOSHBOUGH-JORDAN COMBINATION-GEARED INCLINABLE PRESS

The No. 5 combination-geared, open-backed, inclinable press shown in the accompanying illustration is a recent design added to the line of power presses manufactured by Loshbough-Jordan Tool & Machine Co., Elkhart, Ind. While the design illustrated has the combination gear drive, either a back-geared or a plain flywheel type of drive may be applied to the No. 4 and No. 5 sizes. The flywheel of the press has a solid web, thus eliminating accidents which might result from an open-spoke wheel. The flywheel is provided with a revolvable bushing, and there is a three-point contact in the wheel for the clutch pin with tool-steel striking pins. A large grease cavity in the hub of the wheel provides for self-lubrication. The trip latch has a toggle control, so that it is positively locked until tripped by the foot. The clutch pin may be locked by a safety stop while setting the dies. The press is equipped with an upper knock-out bar in the slide, and there are screw stops for the upper knock-out. A square hole in the slide provides for clamping tightly punch shanks which may be slightly over or under size. The slide is adjusted by a one-piece ball and screw connection, and there is an adjusting nut to compensate for wear on the ball connection. The slide may be adjusted from either side. Provision is made for removable tie-rods.



Loshbough-Jordan Combination-geared Open-back Inclinable Press

SHEFFIELD LEAD-TESTING MACHINE

The lead-testing machine shown in Figs. 1 and 2 was designed by the Sheffield Machine & Tool Co., Dayton, Ohio, to provide a rapid, simple, and accurate method of determining lead errors in screw thread gages. The cast-iron bed of this machine has two parallel dovetail bearings on the top. Upon the rear and larger bearing are mounted the centers for holding the gage to be tested, and upon the front bearing is fitted the sliding block which carries the indicator slide. The indicator is held in place by a small hardened stud, which is clamped in position with a headless set-screw. By mounting the indicator in the proper bushing, the operator is assured of a full bearing of the slide in the block when testing a gage thread. The indicator slide has a knurled stop-screw and lock-nut to insure that the indicator ball point will make contact with the angle of the thread at corresponding points after being set in contact with the first thread.

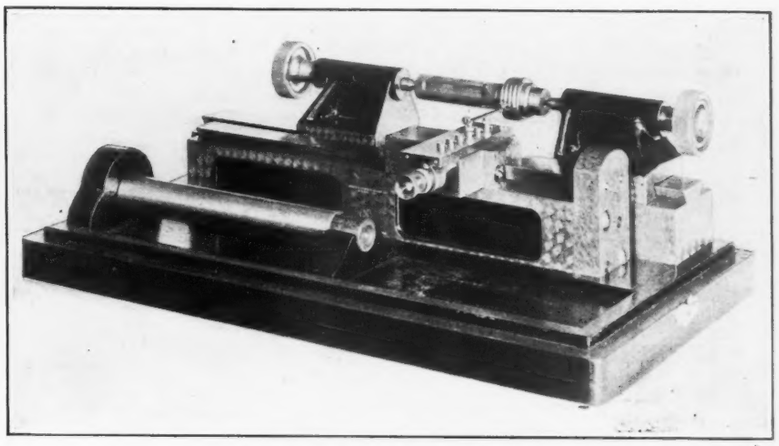


Fig. 1. Sheffield Lead Testing Machine

A better idea of the machine may doubtless be obtained by considering how it is actually used. The gage to be tested is mounted between the centers as shown, the heads being clamped in the required positions by means of knurled binding screws at the rear. A Johansson block is next inserted between suitable contact points to obtain a zero reading. One contact point is on the sliding block and there are two others in the steel plate seen projecting up from the end of the bed. The indicator slide is now moved toward the gage until the ball point of the indicator comes into proper contact with the side of the thread; the stop-screw is then set and locked. The gage is next turned slightly, or is adjusted longitudinally by releasing one center and advancing the other. The adjustment of the centers is obtained by means of the threaded center spindles which have knurled heads. This turning or lengthwise adjusting movement of the gage is continued until the indicator needle is in the zero position. We shall assume, by way of illustration, that the gage has eight threads per inch, and that another Johansson block measuring 0.125 inch is added to the one between the gage points. Then if the lead of the gage thread between these points is perfect, the indicator needle should stand at zero when the ball end is again brought into contact with the thread. If there is even a slight error, the change in the position of the indicator needle will make this apparent. By using other combinations of gage-blocks, the thread may be tested at various points.

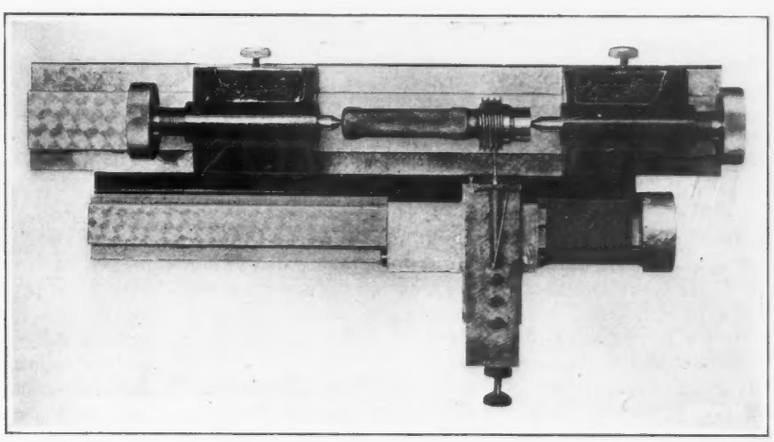


Fig. 2. Plan View of Lead Testing Machine

The Deming indicator, which is also a product of this company, is used and it is graduated to read to 0.0001 inch with standard length ball points and 0.00005 inch with short points. Several sizes of ball points are provided in both lengths; smaller points being used for the finer pitches. This testing device may be applied to either straight or taper gages and with the aid of a chart furnished, the form of the thread may be accurately measured. The hardened and ground test-bar seen at the front of the machine in Fig. 1 is provided for checking the alignment of the two parallel dovetail bearings to detect any wear which might affect the accuracy of the tests.

STUEBING MODEL K LIFTING TRUCK

To meet the requirements of handling loads greater than those ordinarily carried on industrial trucks, the Stuebing Truck Co., of Cincinnati, Ohio, has added to its line a Model K truck, which is illustrated and described herewith. The capacity is for handling loads ranging from 8000 to 14,000 pounds, and to provide the necessary strength and durability for this severe class of service, all parts of the Model K truck are made of steel castings, forgings, or bars. Provision is made for building trucks of any practical width or length to meet the customer's requirements. In working out the design, provision has been made for this variation in size by using a central chassis of standard width and then carrying the side bars or "wings" out sufficiently to handle any specific size of platform on which the load is placed preparatory to transporting it on the elevating truck. These trucks are made with wheels ranging from 6 to 12 inches in diameter by 4 to 6 inches face width. The illustrations show a truck built with especially low wheels for use in transferring heavy machinery from the assembling floor to freight cars in which the ma-

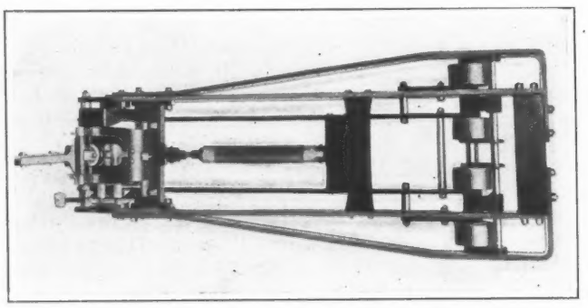


Fig. 1. Top View of Stuebing Model K Lifting Truck

chines are to be shipped. Normally, the frame of the truck will be at a greater distance from the floor. The wheels are mounted on Hyatt heavy-duty roller bearings, so that heavy loads may be moved with a minimum amount of manual effort. The maximum load that can be carried by the truck—14,000 pounds—can be pulled by three men with the truck running on an average floor.

In the operation of this truck, provision has been made for elevating the load by a system of multiplying levers, which greatly reduces the amount of effort required. To further carry out this idea, the design has been worked out in such a way that the majority of the work of elevating the load is accomplished by the up-stroke of the handle by which the truck is pulled. The complete process of elevating is accomplished by one downward, one upward, and a final downward stroke of the handle. On the downward stroke of the handle, pin *A* is in engagement with a hook, as shown in Fig. 2. The trunnion about which the handle swings is located between pins *A* and *B*, and during the downward stroke pin *B* swings into engagement with hook *C*. Then, during the upward stroke of the handle, pin *A* swings into engagement with hook *D*, ready for the second downward stroke of the handle, which is the final step in raising the load.

It will be apparent from the preceding description that during each movement of the truck handle, the pin which is in engagement with one of the hooks causes this hook to be

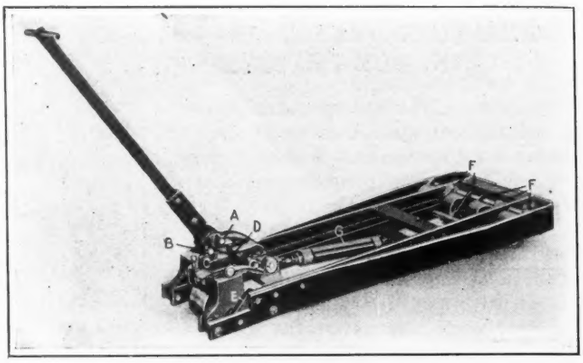


Fig. 2. Front View of Stuebing Truck

pulled forward. The hooks are connected to the elevating platform on the truck, so that a forward movement of the hooks also results in pulling the platform forward. This platform is connected to the truck body by means of two short links or levers *E* at the front of the truck and six corresponding levers *F* at the rear. Hence, it will be apparent that a forward movement of the elevating platform results in raising the platform by swinging it up on levers *E* and *F*. Because of their multiplying effect, these levers enable the maximum load to be lifted with a relatively small manual effort by one man. There is a dashpot *G* on the truck which provides for lowering the load without shock or danger of damaging any parts of the mechanism. In this connection it is important to note that the dashpot allows the truck platform to be lowered, regardless of whether or not there is a load on the truck. The truck itself weighs approximately 1100 pounds, so that this weight facilitates lowering of the platform when unloaded, and the lowering action is further facilitated by a compression spring, which can be brought into action when it is desired to lower the truck rapidly.

KOCH & SANDIDGE ADJUSTABLE CUTTER FOR CUTTING HOLES IN PLATES

A simple and compact form of tool for cutting holes in metal plates is shown in Fig. 1 and the method of using it is illustrated in Fig. 2. This tool is known as the "Jiffy" adjustable cutter, and is made by Koch & Sandidge, 19 S. Wells St., Chicago, Ill. It is designed to cut holes varying from 1¼ to 6 inches in diameter. The standard knives will cut through 3/16-inch steel. Special knives can be supplied for cutting through 1/2-inch steel, and also knives for cutting holes in 1-inch material, such as slate, marble, fiber, etc.

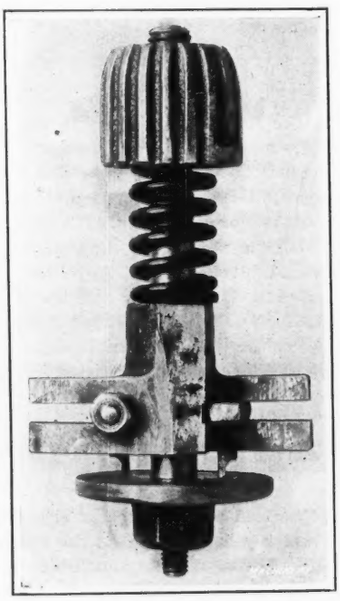


Fig. 1. Koch & Sandidge Adjustable Cutter for cutting Holes in Metal Plates

The tool consists of a swing chuck with two knives adjustable to various centers. The swing chuck is a steel casting. Pressure is put on the knives by means of a heavy spring. Rotation of knives is secured by applying to the swing chuck a special ratchet wrench which is furnished. A 3/8-inch pilot hole is drilled first, and, in the case of thin material, a flange nut is put on the opposite side of the sheet so that the stud may be placed through the pilot hole and screwed

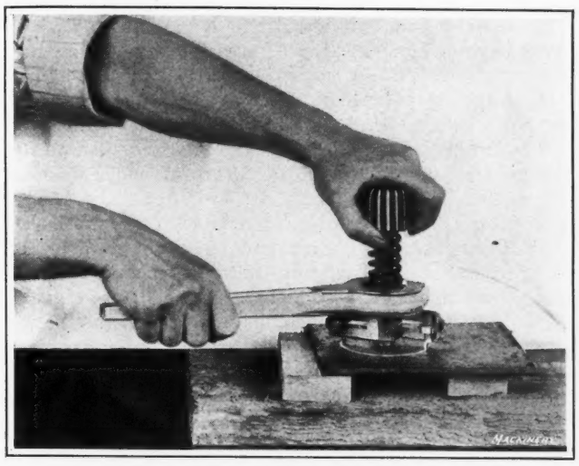


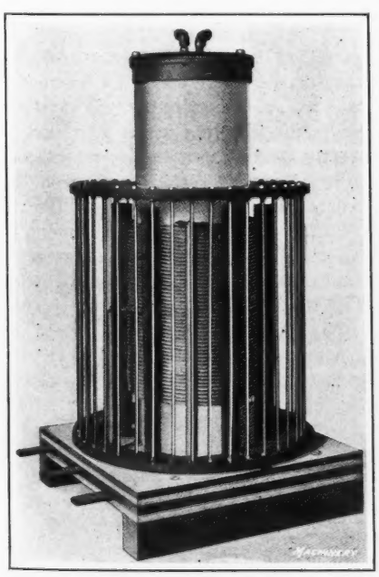
Fig. 2. Method of using Adjustable Cutter

into the flange nut. For cutting heavy material, the pilot hole could be tapped with a standard thread for receiving the stud, thus eliminating the use of the flange nut where it might be difficult to get back of the material to place the flange nut in position. The ratchet wrench is made of malleable iron.

Outside of the many ordinary applications—such as cutting holes in distribution cabinets, boiler tanks, automobile dashboards, etc.—there are many special applications, such as cutting holes in heavy structural steel members and where awkward shaped castings which cannot readily be drilled by machine process are encountered. This tool should prove of value in ship construction and in cutting through plates where it is not practicable to set up gas-flame cutting outfits. Special washers can be quickly cut by setting one of the knives at the inner diameter of the washer and the other at the outer diameter.

NORTHRUP-AJAX HIGH-FREQUENCY INDUCTION FURNACE

The Northrup-Ajax high-frequency induction furnace operates on a new principle in which oscillating currents are used for the generation of heat in the furnace. With this furnace, currents can be set up in the containing crucible, in the case of a non-conducting "melt," or in the melt itself if it has sufficient conductance to permit the flow of currents. No iron is employed for the concentration of magnetic lines of force. This furnace is made by the Pyrolectric Instrument Co., 636-640 E. State St., Trenton, N. J. It is adapted for such work as heat-treatment of metals, the making of special alloys, the melting of glass and non-conducting materials, and for producing temperatures above 1400 degrees C. (2552 degrees F.) without the presence of carbon being essentially associated with the operation of the furnace. This furnace may also be used for producing higher temperatures under controllable conditions of vacuum or pressure and the nature of the atmosphere.

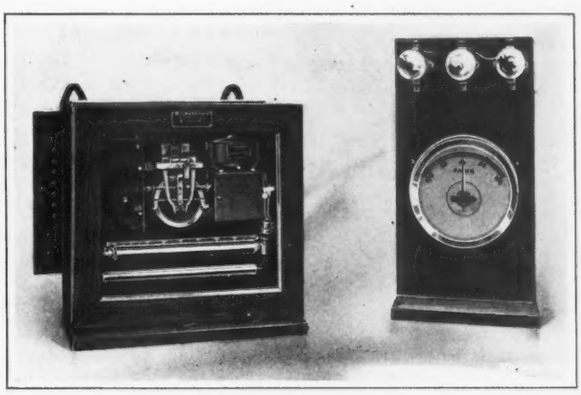


Northrup-Ajax Standard Vacuum Type of High-frequency Induction Furnace

The standard vacuum type of furnace is shown in the illustration. The small units manufactured by the Pyrolectric Instrument Co. are designed for single-phase operation. The oscillatory current system operates at about 8000 volts. This voltage is obtained from a 110- or 220-volt, 60-cycle circuit, by means of a single step-up transformer. The operator is protected when working around the furnace by a grounded metal cage enclosing the inductor coil, and the crucible itself may be grounded. Reliance is placed upon grounding a conducting enclosure rather than upon the strength of insulation. With a "Size E" furnace, using sixteen condenser units, a temperature of not less than 1600 degrees C. (2912 degrees F.) may be obtained in any gas or in vacuum, throughout the volume of a graphite crucible which has an internal diameter of 5 inches and a depth of 12 inches. This temperature may be obtained in less than fifty minutes, starting cold, the power input being under twenty kilowatts. By operating a longer time, a somewhat higher temperature may be obtained. A chrome-alloy crucible can be provided which may be heated to the melting temperature of the alloy. The entire furnace equipment is not subject to wear or depreciation. It is claimed that this type of furnace never burns out and, barring accidents, there is nothing to waste away other than the crucibles. The thermal efficiency of the furnace ranges from 40 to 60 per cent or more of the power input on the switch terminals.

LEEDS & NORTHRUP DOUBLE RECORDER FOR HEATING FURNACES

A modern development in the control of temperatures in heat-treating plants consists of power-operated pyrometers which are not only able to make records but also to control signals for furnace operators and the furnaces themselves. This control is made possible by a mechanism which, although regulated by a very small amount of power available from a thermo-couple, is at the same time able to apply whatever power is necessary for operating electrical switches or controlling valves and dampers. The accompanying illustration shows an automatic controlling recorder at the left and a furnace indicator with lamps at the right, the lamps being used to show by their color if the temperature is correct.



Leeds & Northrup Recorder with Signal Lamp and Indicating Ammeter

Where it is preferred to have the signaling at the furnace done automatically, a "single-point" or curve-drawing recorder is provided with contacts on the moving element by means of which the signal lamps will be lit, accordingly as the temperatures in the furnace are too high, too low, or correct. An interesting extension of this plan is to use two thermocouples in different parts of the furnace and to provide the recorder with a commutator by means of which it reads first on one and then on the other. The chart produced is a single line running alternately back and forth between the two temperatures and indicating the temperature difference graphically. At the same time the commutator controls a fourth signal lamp at the furnace to show which thermocouple is being measured.

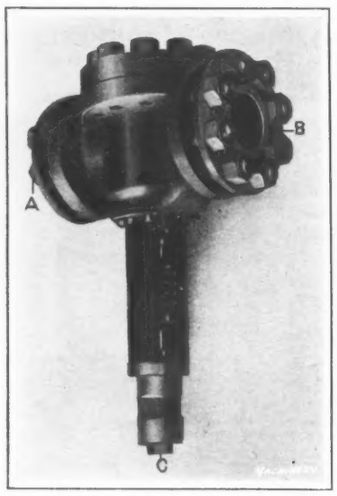
The double recorder is thus suitable for demonstrating uniformity of furnace temperatures or the lack of it. It shows graphically the effects of empty furnace, full furnace, or part full furnace, and how distribution of heat is affected by rates

of firing, location of load, door and other losses, cold hearth, etc. It is a convenient means for investigating furnaces and showing how errors may be overcome by moving burners, baffles, or arches, or changing the method of introducing heat, as by the use of side burners, underfiring, overfiring, number of burners, position of doors, etc. It also shows definitely the effects of the location of thermo-couples, how the readings vary according to their placing with respect to the work and the burners, and also the number of couples to be used.

The use of this double recorder has demonstrated that it is practically impossible to bring many kinds of loads up uniformly to the desired temperature by holding the furnace at a "constant" temperature, without underheating some parts and overheating others. This type of equipment has been found of especial value in studying the heating of different kinds and sizes of sections or numbers of pieces, different methods of loading, speed of loading and unloading, mechanical furnacing, the heat-treatment of large single pieces, such as gun forgings, etc. This apparatus is made by the Leeds & Northrup Co., 4901 Stenton Ave., Philadelphia, Pa.

HYDRAULIC ACCUMULATOR PROTECTIVE VALVE

The hydraulic accumulator shown in the accompanying illustration was designed by the Hydraulic Press Mfg. Co., 84 Lincoln Ave., Mount Gilead, Ohio, in order to apply the safety-first principle to large accumulator systems. This valve is installed directly at the pipe outlet of the accumulator, with the pilot line connecting to some distant point of the piping system. The hydraulic pressure from the pumps lifts the main check and charges the accumulator. At the same time, the pressure lifts the plunger in the small cylinder, thus holding the main check off its seat regardless of whether the accumulator is being charged or discharged, so long as the pressure on the pilot line is maintained. If a break occurs at any point in the piping system, the pressure is immediately reduced. The loss of pressure in the pilot line and small cylinder allows the spring to lower the plunger, and the flow of the liquid, assisted by the spring above the check, causes the latter to seat. The falling of the accumulator is thus prevented. A small T-valve may be inserted in the pilot line, so that by opening it and relieving the pressure on the pilot line the valve may be tested to be sure that it is working properly. This valve may be made to any size required for large accumulators. The accumulator connection is at *A*, the press and pump line connection at *B*, and the pilot line connection at *C*.



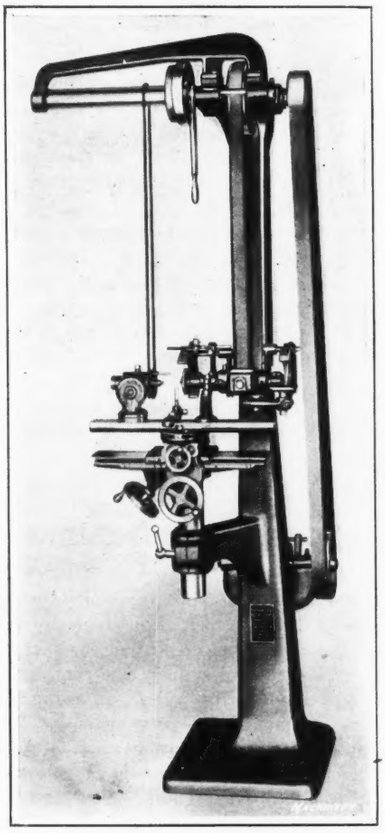
Hydraulic Accumulator Protective Valve

THOMPSON UNIVERSAL CUTTER AND TOOL GRINDER

The universal cutter and tool grinder now being manufactured by the Thompson Grinder Co., Springfield, Ohio, was designed for sharpening all forms of cutters and reamers and, in addition, for performing all the circular, internal, and surface grinding likely to occur in the manufacture of cutters, reamers, counterbores, drill bushings, arbors, and small machine parts. There are three different types of drive for this machine. The particular grinder shown in the accompanying illustration is a self-contained, belt-driven design, having a jack-shaft on the rear of the column. This self-contained design may also be arranged with a motor drive, the motor being attached to the rear of the column. The third type of drive is belt-driven from a countershaft.

This universal grinder may be used for such operations as sharpening spiral milling cutters, side milling cutters, inserted-tooth face mills, end-mills, large or small saws, gear-cutters, form cutters, taps, counterbores, reamers, etc. When sharpening side milling cutters, the teeth may be given either straight or concave clearance. The universal head provided with this machine is so arranged that the tool or cutter may be held in any position that may be required relative to the wheel. This head is adjustable in either a horizontal or vertical plane, and it is provided with a bearing which, in conjunction with bushings, collets, or arbors, may be used for holding various cutting tools in position. As end-mills must of necessity be provided with collets, they can be held securely and accurately by the taper shank and, at the same time, be revolved in a substantial bearing which insures grinding the teeth accurately.

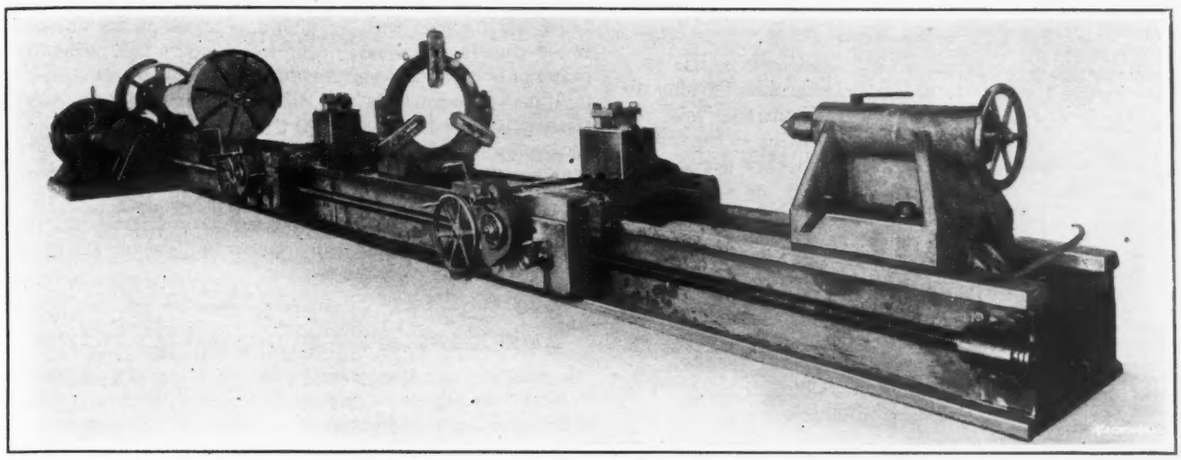
In order to increase the range of this machine, it may be equipped with attachments for cylindrical grinding, internal grinding, surface grinding, concave and convex grinding. The cylindrical grinding attachment is shown applied to the machine in the illustration. This attachment includes the drum for the countershaft with hangers and a weighted lever, a universal head spindle with a pulley for a quarter-inch round belt, a universal chuck, a faceplate with a draw-in collet, and an adjustable dog. The internal grinding attachment is used in connection with the circular grinding attachment. The driving pulley is mounted on the grinding wheel spindle in place of the grinding wheel. The attachment is held on the front of the machine in such a way that the belt may easily be tightened.


Thompson Universal Cutter and Tool Grinder

When the machine is used for surface grinding, the carriage is swiveled at right angles to the grinding wheel spindle and the work is traversed directly under the grinding wheel, the cross-feed being obtained by means of the cross-slide screw. This attachment can be held in the universal head for grinding at any angle. The concave and convex grinding attachment is used when cutters having circular edges are being ground. The center of the attachment is located directly under the front edge of the grinding wheel and the cross-slide is fed in or out to suit the radius required. This attachment is not a part of the regular equipment. Cutter grinding is performed on the left-hand side of this machine, while the right-hand side is arranged for tool grinding. The tool grinding does not interfere in any way with the use or adjustment of the cutter grinding side.

ELYRIA HEAVY-DUTY LATHE

The large heavy-duty lathe here illustrated is suitable for such work as turning guns, propeller shafts, large forgings, etc. This lathe may also be used for projectile work, in which



Heavy-duty 42-inch Lathe for turning Guns, Propeller Shafts, and Similar Work

case it is provided with a shorter bed. The particular lathe illustrated has a 30-foot bed and swings 42 inches over the shears. The maximum distance between the centers with this length of bed is 20 feet. The maximum swing over the carriage is 30 inches. The machine has two carriages, and is driven by a motor which transmits motion to the headstock spindle through gearing, as the illustration shows. This is a 32-horsepower motor, with speed variations ranging from 300 to 1200 revolutions per minute. The ratio between the motor and spindle speeds is 70 to 1. The spindle speeds vary from 4 to 17 per minute. The spindle bearings are babbitted. The size of the front bearing is 12 by 16 inches, and of the rear bearing, 8 by 12 inches. Turning tools made of 1½- by 2¾-inch stock may be used. The shipping weight of the lathe with a 30-foot bed is 49,000 pounds, and the weight is increased 1000 pounds for each additional length of 2 feet. This machine is made by the Elyria Machine Co., Elyria, Ohio.

NEW MACHINERY AND TOOLS NOTES

Lock-nut: Holdfast Nut & Bolt Co., 1405 Corn Exchange Bldg., Chicago, Ill. These nuts have friction metal on one side of the thread which is claimed to adhere firmly to the relatively rough surface of the bolt thread. This metal is on that side of the thread which is not under load stress.

Shell Lathe: Fulton Machine Co., Chicago, Ill. This shell turning lathe is of the single belt drive type and made either in the standard or turret form, as desired. The swing is 20¾ inches over the bed and 9 inches over the tool-slide. It is being marketed by the Dale-Brewster Machinery Co., Chicago, Ill.

Micrometer Height Gage Attachment: Henry O. Costello, 91 Raymond St., Providence, R. I. An attachment for converting an ordinary micrometer into a height gage, thus permitting it to be used the same as a vernier height gage. The measuring points are adjustable so that readings from 0 to 4 inches may be obtained.

Welding Apparatus: Electric Railway Improvement Co., Cleveland, Ohio. A portable arc welding outfit which may be connected to any 110- or 220-volt system. The apparatus is made in two sizes; one weighs 16½ pounds and the other 22 pounds, so that either outfit can readily be carried about.

Tool-holder: Chamberlain Machine Works, Waterloo, Iowa. This tool-holder is designed to hold stellite or the most brittle high-speed steel bits without cracking or breaking. The tool is held in place by a wedge-shaped rack having teeth meshing with a pinion. This pinion is turned by applying a wrench to a square head formed on one side of the pinion.

Punch Press Drawing Attachment: R. D. King, Chicago, Ill. This attachment is used in connection with metal-drawing operations and is designed to provide an equal pressure throughout the entire stroke of the press. The pressure may also be increased or decreased. The press may be used for ordinary blanking without removing the attachment.

Horizontal Boring and Drilling Machine: Newton Machine Tool Works, Inc., 23rd and Vine Sts., Philadelphia, Pa. This machine may be used either as a portable or stationary type. The saddle carrying the spindle may be adjusted vertically on the face of the column, and the latter may be adjusted along the horizontal ways of the base. The spindle has a slow and fast hand feed adjustment.

Rolling Mill Lathe: National Roll & Foundry Co., Avonmore, Pa. Heavy-duty lathe designed for all classes of rolling mill work. The headstock is entirely enclosed with the exception of the faceplate. The motor is directly connected through gearing. Four changes of speed are obtained with the transmission gears, and these changes may be multiplied indefinitely by using a constant-speed motor.

Steel Belt Coupling: Cruban Machine & Steel Corporation, 2 Rector St., New York City. This coupling is formed of sections cut from drawn steel bars of special shape in lengths to suit the width of the belt. The ends of the belt have holes drilled or punched in them to match the screw holes in the coupling. The inner section of the coupling is curved to correspond to the radius of the belt pulley.

Portable Air Compressor: Ingersoll-Rand Co., 11 Broadway, New York City. Motor-driven compressor mounted on a truck having flanged wheels located according to mine track gage. This compressor was designed primarily for mine work, but it may be used whenever compressed air is required for the operation of tools. It is built in several sizes up to a maximum capacity of 415 cubic feet of air per minute and a maximum pressure of 100 pounds per square inch.

Hand Magnet: Cutler-Hammer Mfg. Co., Milwaukee, Wis. A hand magnet for handling small iron and steel parts in quantity, for separating small iron and steel parts from brass, for recovering nails from sweepings, and for similar purposes. The circuit is opened or closed by a trigger located just below the handle. The magnet may be connected with either a 110- or 220-volt direct-current circuit, and it is provided with 5 feet of reinforced flexible cord and a standard attachment plug.

Brazing Torch: Tyler Mfg. Co., 64 Pearl St., Boston, Mass. A portable brazing torch using ordinary illuminating gas for fuel. An air blast is obtained from a small motor-driven blower connecting with the torch through flexible tubing. The motor is a universal type that will operate on either direct or alternating currents. The outfit is designed for connection with ordinary gas supply pipes and electric light systems. It is claimed that with illuminating gas a temperature of 2300 degrees F. may be obtained.

Turret Lathe: A. R. Williams Machinery & Supply Corporation, Buffalo, N. Y. This machine is especially adapted for boring the nose of 6-inch shells and the nose and inside of 4.7-inch shells. The headstock is back-geared and has a two-step cone designed for a 6-inch belt. The spindle has a 1½-inch hole extending through it, and the front of the spindle is recessed 6¼ inches in diameter and 20 inches deep for accommodating a rough 6-inch shell forging. This feature prevents overhang and makes it unnecessary to use steadyrests.

Geared-head Lathe with Single-lever Control: Greaves-Klusman Co., Cincinnati, Ohio. A line of geared-head, single-lever-controlled engine lathes made in 16-, 18-, 20-, 24-, and 30-inch sizes. Any one of ten speed changes may be obtained without stopping the machine and while the tool is cutting, these changes being controlled by a single lever. These machines may be arranged for either a motor drive or a line-shaft drive. The ratio of the direct speeds to those obtained through the back-gears correspond to the correct ratio between finishing and roughing speeds, so that it is simply necessary to shift one lever for making this change.

Dresser for Grinding Wheels: Baldwin, Tuthill & Bolton, Grand Rapids, Mich. A grinding wheel dresser known as the "Metcalf" and consisting of an abrasive wheel of special grade and grain which is mounted on a short shaft between two knobs or handles. These knobs are made of iron to increase the weight and the dresser is held by hand as it is pressed against the wheel to be trued. By holding the dresser in a horizontal position the wheel is given a coarse surface, whereas a close grain surface for finishing is obtained by holding the dresser nearly vertical. It is claimed that this dresser is satisfactory for forming sharp corners on thin delicate wheels as well as for other wheel-truing operations.

USING PIPES AS ROLLERS

BY L. B BREEDLOVE[1]

In the moving of heavy machinery, safes, and similar jobs, it is frequently desirable to use commercial sizes of pipe for rollers, as they will carry a greater concentrated load per pound of metal than solid metal rollers. Owing to the lighter weight and the opening in the center, pipe rollers may also be handled more easily than the solid rollers. Though more expensive than wooden rollers, pipe rollers have a longer life, are more easily turned, and have a lower coefficient of friction.

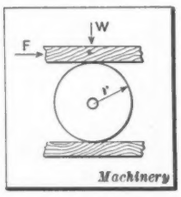


Fig. 1. Diagram showing Application of Force to Load

Rolling friction is, in general, much less than sliding friction. Although few experiments have been made to determine the coefficient of rolling friction, those that have been made seem to indicate that the coefficient is independent of the diameter of the roller. The value of the coefficient of rolling friction for steel rollers on wood varies from 0.06 to 0.10, measured in the same units as the radius. The lower value is taken for hard woods and the larger for soft woods. The value of the coefficient of rolling friction for steel rollers on steel may be taken as 0.003. No definite value of the coefficient of rolling friction for ordinary soft and hard wooden rollers can be assumed as representative, because of the scarcity of data, but the coefficient is larger than those given above. The force F necessary to move a given load W under the conditions given in Fig. 1 is:

$$F = \frac{W}{2r}(a + a_1)$$

where a and a_1 are coefficients of rolling friction for the two contact surfaces. The weight of the roller is neglected. This formula shows that the force necessary to overcome friction varies with the radius of the roller. If hard woods can be secured easily and without much expense, they should be used in connection with the rollers.

As large an outside diameter should be selected for pipe rollers as is deemed practicable under the conditions at hand, and the weight and class of pipe should be such as to safely

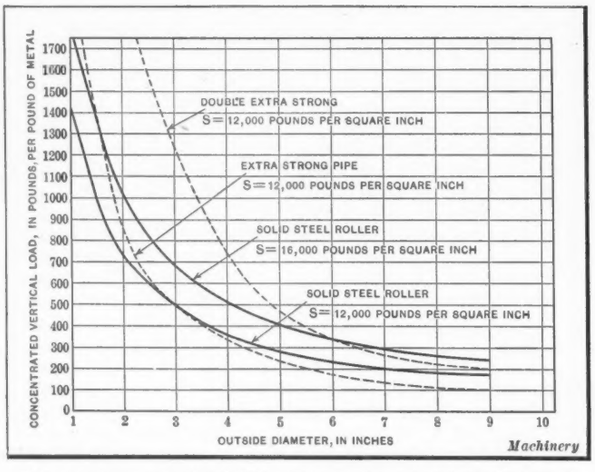


Fig. 2. Curves showing Relation between Concentrated Vertical Load per Pound of Metal and Outside Diameter of Pipe

carry the imposed load with the maximum amount of load per pound of metal. The chart shown in Fig. 2 will be found useful in determining the safe concentrated load for pipe that may be at hand. It shows the relation between the concentrated vertical load in pounds per pound of metal and the outside diameter for commercial sizes of pipes. The loads for the solid rollers were calculated from Juselius' experiments. This chart shows that a solid roller 9 inches in diameter, with an allowable stress in the metal of 12,000 pounds per square inch, will support a concentrated vertical load per pound of metal of 175 pounds; an extra strong pipe, with the same allowable stress, will support 100 pounds; and a double extra strong pipe will support 200 pounds. Both the 3-inch extra strong pipe and the 3-inch solid roller, with an allowable stress in the metal of 12,000 pounds per square inch, will support 500 pounds per pound of metal; pipes smaller than this will support a greater load than the solid rollers, but larger pipes will support a smaller load per pound of metal than the solid rollers. A solid steel roller with an allowable stress in the metal of 16,000 pounds per square inch will support a greater load than the double extra strong pipe with an allowable stress of 12,000 pounds per square inch for sizes larger than 6 inches in diameter. For rollers smaller than 6 inches in diameter, the double extra strong pipe is by far the best.

[1]Address: National Tube Co., Frick Bldg., Pittsburg, Pa.

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AMERICANIZATION IN INDUSTRIAL PLANTS

In a publication issued by the Solvay Process Co., Syracuse, N. Y., relating to the Americanization of foreigners working in industrial plants through the agency of the management, it is suggested that industrial organizations make a careful census of all non-Americans in their employ and examine the ability of these men and women in the speaking and reading of the English language. The following specific suggestions are also made:

Foremen should be asked and encouraged to cooperate with Americanization work, and through meetings, at some of which outside men of national reputation should speak, they should be given an opportunity to come in contact with the most advanced ideals of Americanization work.

An educational scheme should be adopted in cooperation with the public school system, with classes held at such times as will allow the men or women to attend them either in going to or returning from their work, and the classrooms should be so selected that their location will make it convenient for the employes to attend the classes. For this work, teachers should be hired for full time, and no one should be asked to give his services without proper remuneration. The course offered should be in English and citizenship and should give the student a clear conception of American ideals, a preparation for the taking out of his citizenship papers and a fair command of the language. The attendance of the foreigners who do not understand the English language should be made compulsory and they should be paid for the time spent in the class-room at the average rate of their regular employment. Attendance of the citizenship classes should be voluntary and the men should receive no pay for attending these classes. Classes in English should be held at least twice a week with a minimum of one-half hour at each time and the citizenship class should meet at least for half an hour once a week. No definite increase of wages should be offered for attendance, but advancement of those that show active interest in becoming Americanized should be made wherever possible.

In view of the fact that the military draft requires more and more of our young American-born workers, the foreign-born men and women will constitute a source of labor that is becoming ever more important. Anything that is done to further the Americanization of foreign-born workers is of the greatest importance not only as a national policy, but as a question of management of industrial plants.

* * *

Applications for examination for a commission in the Engineer Reserve Corps will be received from qualified engineers, if made on special blanks which may be obtained from the office of the Chief of Engineers, Washington, D. C., and sent to that office, together with the experience data required, and with the name of the city in which it is desired to be examined. When these applications have been received at the office of the Chief of Engineers, the qualifications of the applicants will be considered and those selected will be notified when to appear at the designated place for the professional and physical examination, which will be conducted by a board of officers sent out from Washington, D. C. The papers of those who qualify will be sent to the Chief of Engineers at Washington, who will take the necessary steps to have them commissioned as officers in the Engineer Reserve Corps.

TRAINING DEPARTMENT OF THE NORTON GRINDING CO.[1]

BY J. C. SPENCE[2]

The Norton Grinding Co. realized as early as 1915 the uselessness of attempting to hire skilled men in a community having so many mechanical industries as Worcester, Mass., and for that reason started a training department in its plant. It has been developed along very simple lines and could be duplicated at any factory practically without cost. In order to start a training department, only two things are necessary: (1) A manager who really wants to help the country to win this war to an extent that he will do his share in breaking in green men; (2) a workman or foreman who has the knowledge and patience to teach green help.

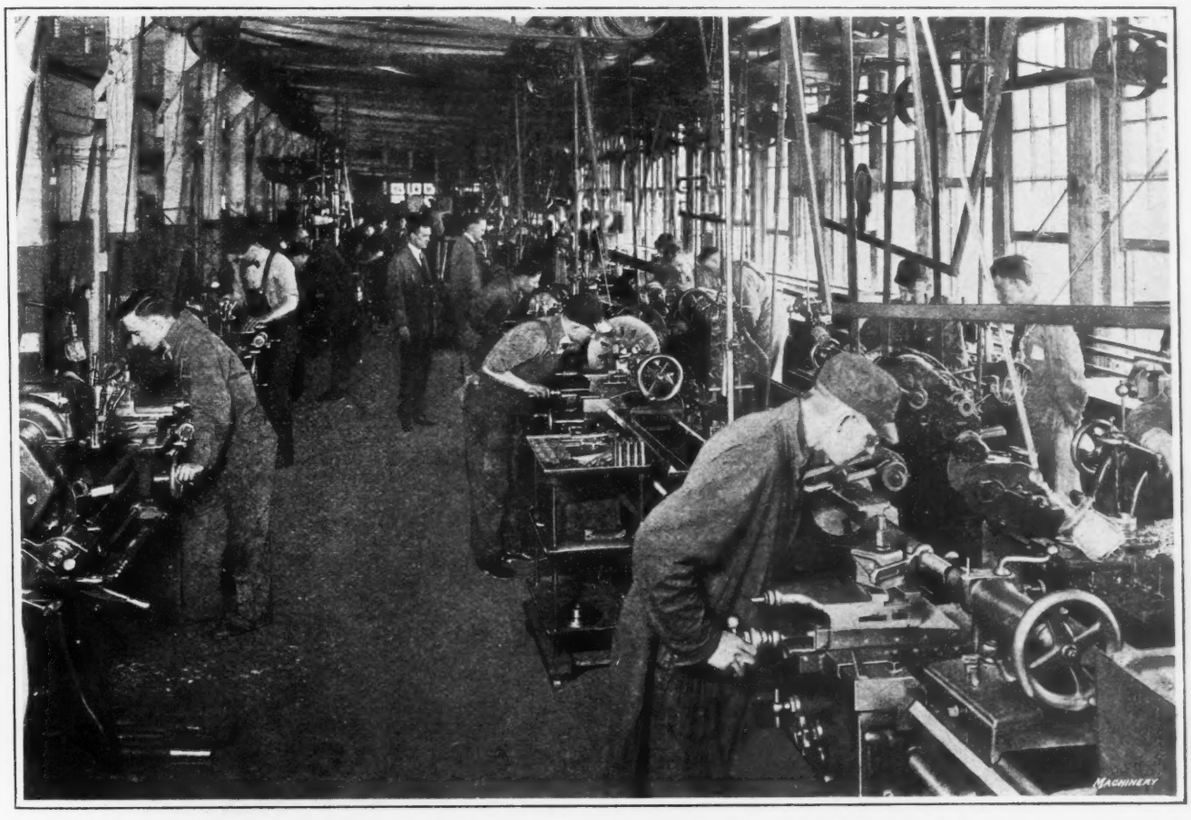
The first objection raised by most machine shop managers is that they have neither the necessary equipment nor the floor space. This idea, however, is usually erroneous, because in every department of a machine shop there is generally a certain amount of simple work to be done. This applies even to the tool-room. It is the custom to give this simple work to the less skilled men and to use the older machine tools for this purpose. This being the case, it is a simple matter to take a number of these machines and concentrate them in one department. Some rearrangement of the shop may be necessary, but this may even be an advantage, as most shops would profit by such a rearrangement of the machines.

After a place has been provided for the training department, it should be started in a small way with one instructor and a few green men. It may be necessary to overcome the deep-rooted resentment on the part of some foremen and workmen who have served a long term of apprenticeship and who object to this rapid method of training help. This objection, however, may be overcome by starting in a small way and by letting it be understood that the school is not intended to produce real machinists, but simply to take from the shoulders of the foremen the burden of breaking in green help.

In the Norton training department no attempt is made to train specialists. The boys and men are given an opportunity to learn a little of all the common machine shop operations, because it is not always known in which department of the shop the man will finally be placed. When an opening occurs, the head instructor of the training department assigns to it the man he thinks is best fitted for the job, regardless of the length of time that he has served in the training department. The last man in might be the first man out, provided he has the qualifications for the job.

The training department runs along as a department of the shop, having its own schedule to meet in the production of single parts and assembled mechanisms. This schedule calls for about one-half the available labor of the department. To fill in the remainder of the time, odd jobs are picked up throughout the plant. The foremen welcome this odd-job department, as it rids them of the many bothersome small jobs that interfere with regular production but that make fine training for beginners and that usually call for the use of several different kinds of machine tools. The tool-room also turns over to the training school its roughing work. If by chance the training department should run low in the right kind of work, the head instructor requests the main shop to supply that kind of work. For instance, if it were necessary to obtain some work for training men in cutting threads in an engine lathe, this work may even be taken away from the turret lathes in the main shop, even though the resulting threads cut would cost ten times as much as they ought to. However, it is a good deal cheaper in the long run to pay a little more for training than to continually pay for the abnormal conditions created by manufacturers hiring help from one another.

In the Norton Grinding Co.'s plant men who have been working in some other line than mechanical work are taken into the plant at the prevailing wage for common labor. Just now, in the Worcester section, this is thirty-five cents per hour, which is an inducement for many men, especially as there is the additional advantage of being able to make a good start toward learning the machinist's trade. Boys not less than sixteen years of age are also taken in the training department. These are paid according to experience and the likelihood of their making good.



The Norton Co.'s Training School for Machine Operators—A Successful Means for meeting the Labor Shortage

[1] Abstract of paper read at the spring meeting of the American Society of Mechanical Engineers, in Worcester, Mass., June 4 to 7, 1918.

[2] Superintendent, Norton Grinding Co., Worcester, Mass.

USING PIPES AS ROLLERS

BY L. B BREEDLOVE[1]

In the moving of heavy machinery, safes, and similar jobs, it is frequently desirable to use commercial sizes of pipe for rollers, as they will carry a greater concentrated load per pound of metal than solid metal rollers. Owing to the lighter weight and the opening in the center, pipe rollers may also be handled more easily than the solid rollers. Though more expensive than wooden rollers, pipe rollers have a longer life, are more easily turned, and have a lower coefficient of friction.

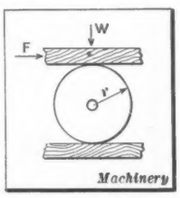


Fig. 1. Diagram showing Application of Force to Load

Rolling friction is, in general, much less than sliding friction. Although few experiments have been made to determine the coefficient of rolling friction, those that have been made seem to indicate that the coefficient is independent of the diameter of the roller. The value of the coefficient of rolling friction for steel rollers on wood varies from 0.06 to 0.10, measured in the same units as the radius. The lower value is taken for hard woods and the larger for soft woods. The value of the coefficient of rolling friction for steel rollers on steel may be taken as 0.003. No definite value of the coefficient of rolling friction for ordinary soft and hard wooden rollers can be assumed as representative, because of the scarcity of data, but the coefficient is larger than those given above. The force F necessary to move a given load W under the conditions given in Fig. 1 is:

$$F = \frac{W}{2r}(a + a_1)$$

where a and a_1 are coefficients of rolling friction for the two contact surfaces. The weight of the roller is neglected. This formula shows that the force necessary to overcome friction varies with the radius of the roller. If hard woods can be secured easily and without much expense, they should be used in connection with the rollers.

As large an outside diameter should be selected for pipe rollers as is deemed practicable under the conditions at hand, and the weight and class of pipe should be such as to safely

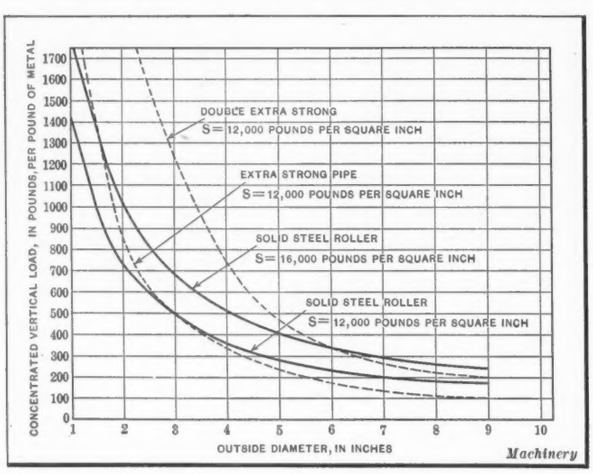


Fig. 2. Curves showing Relation between Concentrated Vertical Load per Pound of Metal and Outside Diameter of Pipe

carry the imposed load with the maximum amount of load per pound of metal. The chart shown in Fig. 2 will be found useful in determining the safe concentrated load for pipe that may be at hand. It shows the relation between the concentrated vertical load in pounds per pound of metal and the outside diameter for commercial sizes of pipes. The loads for the solid rollers were calculated from Juselius' experiments. This chart shows that a solid roller 9 inches in diameter, with an allowable stress in the metal of 12,000 pounds per square inch, will support a concentrated vertical load per pound of metal of 175 pounds; an extra strong pipe, with the same allowable stress, will support 100 pounds; and a double extra strong pipe will support 200 pounds. Both the 3-inch extra strong pipe and the 3-inch solid roller, with an allowable stress in the metal of 12,000 pounds per square inch, will support 500 pounds per pound of metal; pipes smaller than this will support a greater load than the solid rollers, but larger pipes will support a smaller load per pound of metal than the solid rollers. A solid steel roller with an allowable stress in the metal of 16,000 pounds per square inch will support a greater load than the double extra strong pipe with an allowable stress of 12,000 pounds per square inch for sizes larger than 6 inches in diameter. For rollers smaller than 6 inches in diameter, the double extra strong pipe is by far the best.

[1]Address: National Tube Co., Frick Bldg., Pittsburg, Pa.

* * *

AMERICANIZATION IN INDUSTRIAL PLANTS

In a publication issued by the Solvay Process Co., Syracuse, N. Y., relating to the Americanization of foreigners working in industrial plants through the agency of the management, it is suggested that industrial organizations make a careful census of all non-Americans in their employ and examine the ability of these men and women in the speaking and reading of the English language. The following specific suggestions are also made:

Foremen should be asked and encouraged to cooperate with Americanization work, and through meetings, at some of which outside men of national reputation should speak, they should be given an opportunity to come in contact with the most advanced ideals of Americanization work.

An educational scheme should be adopted in cooperation with the public school system, with classes held at such times as will allow the men or women to attend them either in going to or returning from their work, and the classrooms should be so selected that their location will make it convenient for the employes to attend the classes. For this work, teachers should be hired for full time, and no one should be asked to give his services without proper remuneration. The course offered should be in English and citizenship and should give the student a clear conception of American ideals, a preparation for the taking out of his citizenship papers and a fair command of the language. The attendance of the foreigners who do not understand the English language should be made compulsory and they should be paid for the time spent in the class-room at the average rate of their regular employment. Attendance of the citizenship classes should be voluntary and the men should receive no pay for attending these classes. Classes in English should be held at least twice a week with a minimum of one-half hour at each time and the citizenship class should meet at least for half an hour once a week. No definite increase of wages should be offered for attendance, but advancement of those that show active interest in becoming Americanized should be made wherever possible.

In view of the fact that the military draft requires more and more of our young American-born workers, the foreign-born men and women will constitute a source of labor that is becoming ever more important. Anything that is done to further the Americanization of foreign-born workers is of the greatest importance not only as a national policy, but as a question of management of industrial plants.

* * *

Applications for examination for a commission in the Engineer Reserve Corps will be received from qualified engineers, if made on special blanks which may be obtained from the office of the Chief of Engineers, Washington, D. C., and sent to that office, together with the experience data required, and with the name of the city in which it is desired to be examined. When these applications have been received at the office of the Chief of Engineers, the qualifications of the applicants will be considered and those selected will be notified when to appear at the designated place for the professional and physical examination, which will be conducted by a board of officers sent out from Washington, D. C. The papers of those who qualify will be sent to the Chief of Engineers at Washington, who will take the necessary steps to have them commissioned as officers in the Engineer Reserve Corps.

TRAINING DEPARTMENT OF THE NORTON GRINDING CO.[1]

BY J. C. SPENCE[2]

The Norton Grinding Co. realized as early as 1915 the uselessness of attempting to hire skilled men in a community having so many mechanical industries as Worcester, Mass., and for that reason started a training department in its plant. It has been developed along very simple lines and could be duplicated at any factory practically without cost. In order to start a training department, only two things are necessary: (1) A manager who really wants to help the country to win this war to an extent that he will do his share in breaking in green men; (2) a workman or foreman who has the knowledge and patience to teach green help.

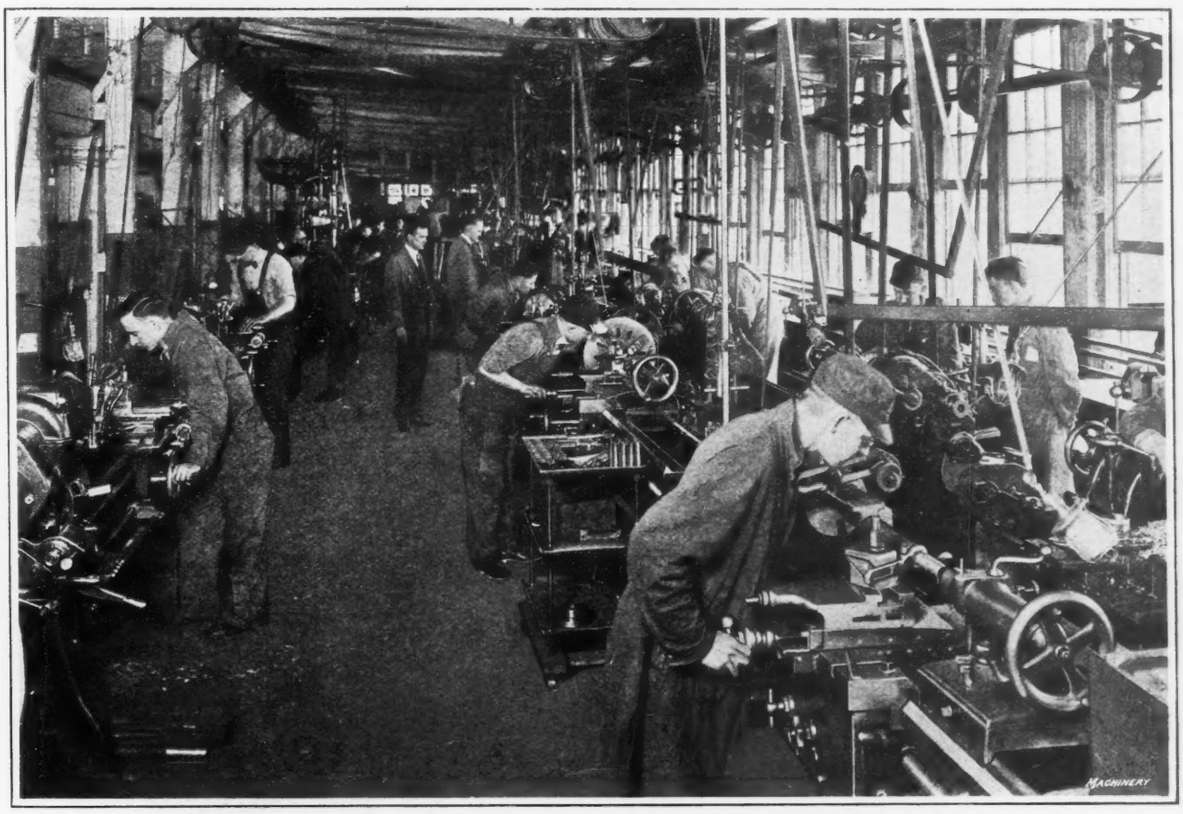
The first objection raised by most machine shop managers is that they have neither the necessary equipment nor the floor space. This idea, however, is usually erroneous, because in every department of a machine shop there is generally a certain amount of simple work to be done. This applies even to the tool-room. It is the custom to give this simple work to the less skilled men and to use the older machine tools for this purpose. This being the case, it is a simple matter to take a number of these machines and concentrate them in one department. Some rearrangement of the shop may be necessary, but this may even be an advantage, as most shops would profit by such a rearrangement of the machines.

After a place has been provided for the training department, it should be started in a small way with one instructor and a few green men. It may be necessary to overcome the deep-rooted resentment on the part of some foremen and workmen who have served a long term of apprenticeship and who object to this rapid method of training help. This objection, however, may be overcome by starting in a small way and by letting it be understood that the school is not intended to produce real machinists, but simply to take from the shoulders of the foremen the burden of breaking in green help.

In the Norton training department no attempt is made to train specialists. The boys and men are given an opportunity to learn a little of all the common machine shop operations, because it is not always known in which department of the shop the man will finally be placed. When an opening occurs, the head instructor of the training department assigns to it the man he thinks is best fitted for the job, regardless of the length of time that he has served in the training department. The last man in might be the first man out, provided he has the qualifications for the job.

The training department runs along as a department of the shop, having its own schedule to meet in the production of single parts and assembled mechanisms. This schedule calls for about one-half the available labor of the department. To fill in the remainder of the time, odd jobs are picked up throughout the plant. The foremen welcome this odd-job department, as it rids them of the many bothersome small jobs that interfere with regular production but that make fine training for beginners and that usually call for the use of several different kinds of machine tools. The tool-room also turns over to the training school its roughing work. If by chance the training department should run low in the right kind of work, the head instructor requests the main shop to supply that kind of work. For instance, if it were necessary to obtain some work for training men in cutting threads in an engine lathe, this work may even be taken away from the turret lathes in the main shop, even though the resulting threads cut would cost ten times as much as they ought to. However, it is a good deal cheaper in the long run to pay a little more for training than to continually pay for the abnormal conditions created by manufacturers hiring help from one another.

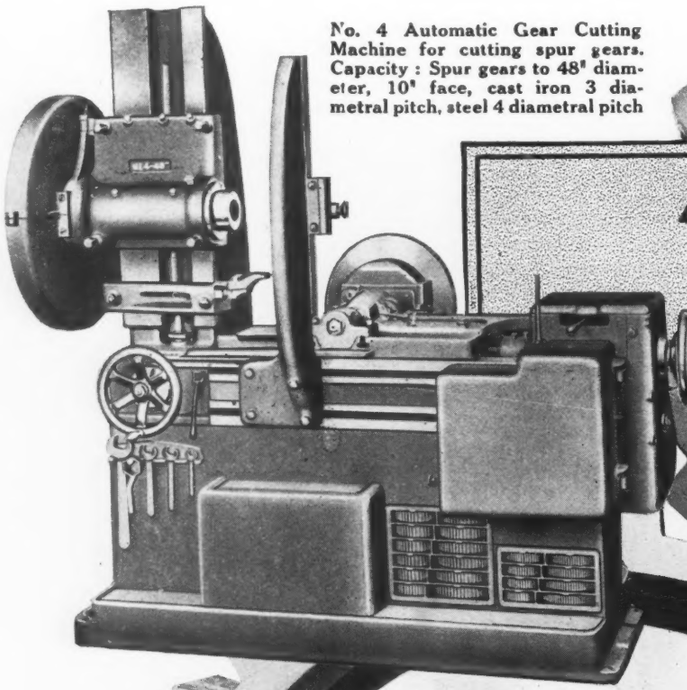
In the Norton Grinding Co.'s plant men who have been working in some other line than mechanical work are taken into the plant at the prevailing wage for common labor. Just now, in the Worcester section, this is thirty-five cents per hour, which is an inducement for many men, especially as there is the additional advantage of being able to make a good start toward learning the machinist's trade. Boys not less than sixteen years of age are also taken in the training department. These are paid according to experience and the likelihood of their making good.



The Norton Co.'s Training School for Machine Operators—A Successful Means for meeting the Labor Shortage

[1] Abstract of paper read at the spring meeting of the American Society of Mechanical Engineers, in Worcester, Mass., June 4 to 7, 1918.

[2] Superintendent, Norton Grinding Co., Worcester, Mass.



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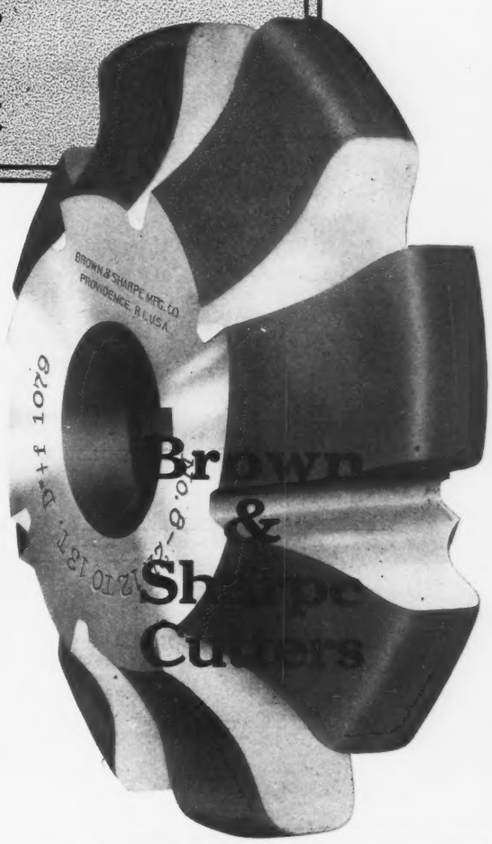
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CHARLES E. HUGHES' OPINION ON NEW SECOND-CLASS POSTAL RATES

In a letter addressed to Allen H. Richardson, of the Publishers Advisory Board, New York City, Charles E. Hughes expresses his ideas as to the iniquity and danger of the new second-class postal rates and the zone system adopted in connection with the new rates in the following words:

"I have no hesitation in saying that I regard the zone system of postal rates for newspapers and periodicals, coming under the definition of second-class mail matter, as ill advised. The Commission on Second-class Mail Matter (appointed in 1911), of which I was a member, considered this question and reported unanimously against the zone system. We said in that report:

> The policy of zone rates was pursued in the earlier history of our post office and has been given up in favor of a uniform rate in view of the larger interest of the nation as a whole. It would seem to the commission to be entirely impracticable to attempt to establish a system of zone rates for second-class matter. . . . Progress in the post office, with respect both to economy in administration and to public convenience, leads away from a variety of differential charges to uniform rates and broad classifications.

"In my judgment, the zone system for second-class mail matter is unjust to the publisher and unjust to the public. It not only imposes upon the publisher the additional rates upon a sectional basis, but it makes necessary the added expense for the necessary zone classifications at a time when every economy in production and distribution is most important. It introduces a complicated postal system to the inconvenience of the publisher and public when there should be a constant effort toward greater simplicity. There is no more reason for a zone system of rates for newspapers and magazines than for letters. Newspapers and magazines are admitted to the second-class postal rates on the well-established policy of encouraging the dissemination of intelligence, but a zone system is a barrier to this dissemination. If it is important that newspapers and magazines should be circulated, it is equally important that there should not be sectional divisions to impede their circulation through the entire country.

"We are proud at this moment of our united purpose, but if we are to continue as a people to cherish united purposes and to maintain our essential unity as a nation, we must foster the influences that promote unity. The greatest of these influences, perhaps, is the spread of intelligence diffused by newspapers and periodical literature. Abuses in connection with second-class mail matter will not be cured by a zone system of rates. That will hurt the good no less than the bad, and perhaps some of the best sort of periodical literature will be hit the hardest. We do not wish to promote sectionalism, and 'one country' means that in our correspondence and in the diffusion of necessary intelligence we should have a uniform postal rate for the entire country. The widest and freest interchange is the soundest public policy. I hope that Congress will repeal the provision for the zone system, which is decidedly a looking-backward and walking-backward measure."

* * *

NATIONAL SOCIETY FOR THE RECONSTRUCTION OF BELGIUM

In order to shorten the time necessary for Belgium to resume its place among the industrial nations of the world, a cooperative society known as "Comptoir National pour la Reprise de l'Activite Economique en Belgique" has been formed. Its object is to further the economical reconstruction of Belgium and it cooperates with and is under the control of the Belgian Government. Its work is to assist the industries in purchasing tools and raw materials, so that work can begin in the reconstructed shops in the shortest possible time. The society is therefore interested in everything—metallurgy, materials for construction of buildings, leathers, textiles, farming implements, chemical products, machine tools, electrical material, optical instruments, motor cars, vans, wagons, oils and greases of all kinds, refractory materials, etc. It is requested that catalogues and price lists, in triplicate, be sent to the society, 15 rue Louis-le-Grand, Paris, so that orders may be placed as soon as possible.

HELPING UNCLE SAM

The Bureau of Oil Conservation, Oil Divison, United States Fuel Administration, is desirous of securing a combustion engineer for each of the following districts, who will act as an inspector visiting all plants within his district using fuel oil and natural gas: Boston, Providence, New York City, Philadelphia, Pittsburg, Buffalo, Detroit, Chicago, Minneapolis, Tulsa, New Orleans, and San Francisco. It is desirable to have these men act as volunteers where possible, but the Administration is prepared to pay a reasonable compensation for men who cannot afford to give their services to the Government. Only men who have had experience in fuel oil and natural gas combustion would be of value.

The Patent Office requires technically trained persons for its examining corps. Men or women are desired who have a scientific education, particularly in higher mathematics, chemistry, physics, and French or German, and who are not subject to the draft for military service. Engineering or teaching experience, in addition to the above, is valued. The entrance salary is $1500. Examinations for the position of assistant examiner are held frequently by the Civil Service Commission at many points in the United States. One is announced for August 21 and 22, 1918. Details of the examination, places of holding the same, etc., may be had upon application to the Civil Service Commission, Washington, D. C., or to the United States Patent Office, Washington, D. C. Should the necessity therefor arise, temporary appointments of qualified persons may be made pending their taking the Civil Service examination. Application for such appointment should be made to the United States Patent Office, Washington, D. C.

The Bureau of Standards has established a branch of its gage section, at Cleveland, Ohio. This section was opened prepared to receive gages for test on July 1. It is located in the Plymouth Building, 22nd St. and Prospect Ave. The District Office of the Inspection Division of the Ordnance Department is also located in this building. The branch gage laboratory in Cleveland is mainly intended for taking care of muntion limit gage tests in the Cleveland district, and all gages which are ordered by the War Department for test at the Bureau of Standards and delivery in Washington should be submitted directly to the Bureau of Standards, Washington, D. C.

There are available at this branch laboratory facilities for the test of all types of munition limit gages. Equipment has been installed which is practically a duplication of the various machines and special devices used at the Bureau of Standards in Washington, for the test of plain plug and ring gages, profile, and other forms of gages, and especially screw thread gages. The facilities of this branch laboratory are available, without charge, to manufacturers carrying out government contracts for munitions of war. Gages may be submitted by mail, express, or by messenger. When gages are shipped, it is recommended that, whenever possible, they be sent by registered or insured mail, rather than by express, on account of the saving of time. It is requested that all mail and gage shipments be specifically addressed as follows: "Bureau of Standards, Branch Gage Section, Plymouth Building, Cleveland, Ohio."

Persons submitting gages for test are requested to furnish complete information as to the identification and classification of the gages, instructions for test and shipment, and also information such as drawings and specifications, which establish the important dimensions of the gages submitted. If copies of drawings for the Ordnance Office or other gage drawings or part drawings for the Government are submitted with the gages, it will greatly facilitate the test and permit the sealing of the gages.

* * *

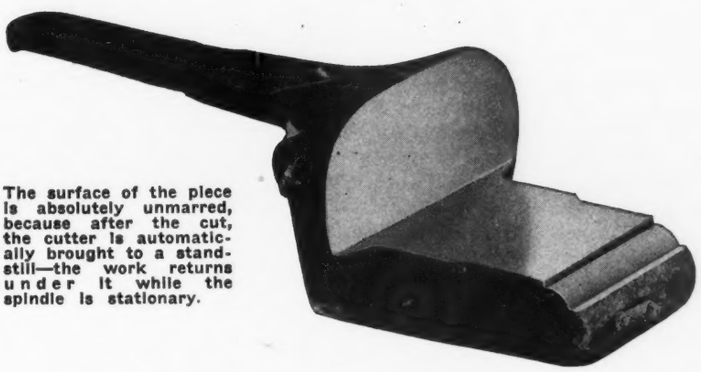
The Richardson Research Laboratory, of Cleveland, Ohio, has succeeded in making a fine platinum wire for cross-hairs in telescopes, which is said to be 0.000795 inch in diameter.

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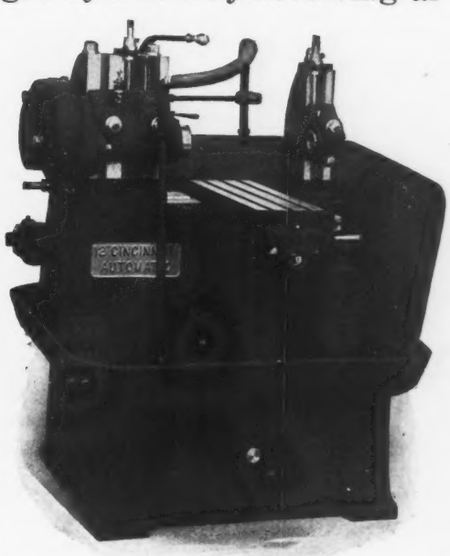
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SOME KNOTTY LABOR PROBLEMS

BY ROBERT MAWSON

The editorial "Some Knotty Labor Problems" appearing in the July number of MACHINERY, on page 988, gives food for thought on a subject which is of great importance to the machine tool industry. The labor situation in the small shops which employ a comparatively small number of men has never been more acute or difficult to handle than it is at the present time. In most small shops where less than twenty men are employed, it is necessary to exercise the utmost care in dealing with the employes, as the success of the small shop depends on the individual effort of every employe to a greater extent than does the success of a large shop where hundreds of men are employed. In small shops, the problem of making the business pay is much more difficult than it is in a larger concern, due not only to the labor question but to the small reserve capital usually carried by small concerns and to the narrow margin of spoiled work in a small shop. In many large shops, 5 to 10 per cent of spoiled work is not uncommon, while if a loss of 5 per cent of the products of small concerns is experienced for any length of time, the business might soon become bankrupt. Under these conditions, the employes who prove most satisfactory are men who have had general machine shop practice and have become good all-around machinists.

But right here comes the problem: The good all-around men have graduated over night from machinists to toolmakers and command wages that the small shop cannot pay. The men, therefore, who look for work in small shops are either transient toolmakers demanding rates per hour that cannot profitably be paid, or totally unskilled men. An instance citing the unsatisfactory employment of a man belonging to the former class is given to illustrate some of the difficulties experienced in the employment of this class of men. This man gave a resumé of his experience and training and said he wanted a job in a small shop, as he was tired of the large shops. The firm gave him the rate of pay asked for and he began work. Then the trouble began: First, the shop was not as well lighted as those he had been used to; second, the shop was not kept at the particular temperature that he desired. This fault-finding was, of course, absurd; the man apparently expected the shop to be run for his particular benefit instead of as a business institution established for the purpose of making a living for the owner. But the point is that under normal business conditions the man would not have resorted to this method of fault-finding. The chief trouble, however, was his refusal to do what he considered general machinists' work—in other words, he expected to choose his own work. This, of course, is an impossible condition in a small shop, and his services had to be dispensed with.

A case exemplifying the difficulties experienced in hiring unskilled men occurred in the same shop. A man claiming to be a good machinist was employed in the shop. The first piece of work given him was a simple lathe job. He started up the lathe, but the foreman noticed that the lathe center was squeaking and advised him to put oil on it. The man took the shaft out from between the centers and then carefully put a large quantity of oil on both centers, the live one as well as the dead center. However, he later became a good all-around machinist. After a little candid talk with the foreman, he acknowledged his lack of experience and knowledge as a machinist. He was, however, ready to accept suggestions, and acting upon them, profited thereby.

In view of the existing conditions, the writer believes that the following method would prove satisfactory in dealing with the labor problem: When a man applies for another job in the same vicinity, he must first tell where he is working, or where he worked last, and state what rate of pay he expects. Let it be assumed he asks 55 cents per hour. The second shop foreman should then call up the first shop and say, "Mr. Smith, who worked for you, is here looking for a job and asks 55 cents per hour; we don't know what you paid him, but if you care to meet his figure you can retain him; if not, we are going to hire him."

The writer believes this would help in solving the labor problem. If the first shop foreman thought the man worth the increase, he would get it; the firm would retain their man, and he would be satisfied. This would also create a feeling of cooperation between the various shops engaged on government work, to the mutual advantage of all concerned.

* * *

The Bureau of Standards, Washington, D. C., announces that the bureau will conduct classes of instruction covering the measurements and use of munition limit gages. Two courses have been planned: Course A, which will cover a period of about three weeks, and Course B which will cover a period of about one week. It is intended in these courses of instruction to place in the hands of persons who are using and inspecting gages such information as has been secured by the Bureau of Standards in the test and standardization of munition limit gages.

Course A is intended primarily for men who are directly occupied in gage work, such as gage checkers, foremen of gage shops, or gage inspectors. It is intended to give a complete working knowledge of the measurement of various types of munition gages, together with information as to the acceptance or rejection of gages, and other information pertaining to the use of master gages. Course B is intended for persons who are not directly employed in checking gages, and it aims to convey a general knowledge regarding gaging requirements and fundamentals rather than complete details of gage measurement. The instruction will be accompanied with actual work in the testing and handling of such gages as may be submitted for test during the time classes are being given.

The advantages to be secured in either one of the previously mentioned courses of instruction are available to any government inspector or employe who has to do with the use or measurement of gages. The same opportunities will also be afforded the inspectors or employes of manufacturers carrying out government contracts for war material.

In order for anyone to arrange for either one of the courses of instruction, it is only necessary to make application to the Director, Bureau of Standards, Washington, D. C., through the chief of the office, division, or manufacturer by which the applicant is employed. Such a letter should make clear the exact position which the applicant occupies and the course of instruction desired, and complete evidence that the applicant is absolutely loyal to the United States Government. Applications should be made two or three weeks in advance of the time the applicant desires to report at the Bureau of Standards for instructions.

* * *

CONVENTION OF ELECTRIC HOIST MANUFACTURERS' ASSOCIATION

The Electric Hoist Manufacturers' Association held its June meeting at Montour Falls, N. Y., where the members of the association were the guests of the Shepard Electric Crane & Hoist Co. Twenty-two members were present, representing the following companies: Brown Hoisting Machinery Co., Cleveland, Ohio; Detroit Hoist & Machine Co., Detroit, Mich.; Euclid Crane & Hoist Co., Euclid, Ohio; Link-Belt Co., Nicetown, Pa.; Roeper Crane & Hoist Works, Reading, Pa.; Shepard Electric Crane & Hoist Co., Montour Falls, N. Y.; Sprague Electric Works, New York City; and Yale & Towne Mfg. Co., New York City.

The general topic of the meeting was war service, and the general discussion was directed along lines for coordinating the experience and facilities of the electric hoist manufacturers to be of the most direct and efficient service to the Government for war requirements. The consensus of opinion of the electric hoist manufacturers is that government orders for war purposes should take precedence over all other orders, and if war requirements call for the complete output of all of the manufacturers of electric hoists, it will be desirable to refuse all other business. The most instructing and interesting event of the meeting was a detailed inspection of the plant of the Shepard Electric Crane & Hoist Co., covering design, manufacturing, shop costs, testing, technical history of installations, and welfare work.

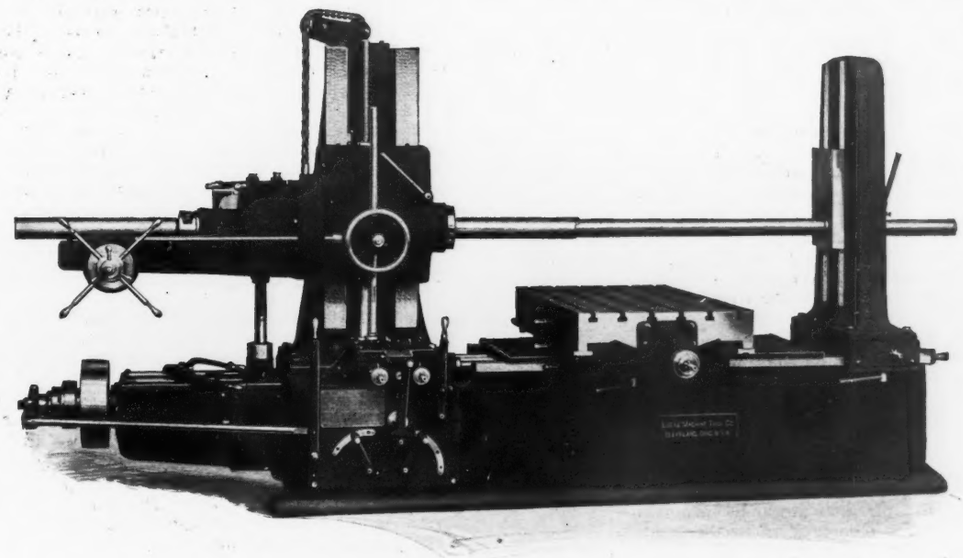
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PERSONALS

L. G. HENDERSON, secretary and treasurer of Russell, Holbrook & Henderson, Inc., 30 Church St., New York City, has joined the Coast Artillery of the United States Army.

W. H. CALLAN, general manager plants, and W. P. PRESSINGER, general manager sales, have been elected vice-presidents of the Chicago Pneumatic Tool Co., Chicago, Ill.

CHESTER C. RAUSCH has been appointed assistant to the director of the American Museum of Safety. Mr. Rausch has had a wide experience in engineering, safety, and industrial work.

GEORGE W. AGERTER, for eight years with the Hunter Saw & Machine Co., is now representative in the Pittsburg district for the Ludlum Steel Co., Watervliet, N. Y., with office in Cleveland, Ohio.

H. O. PENLAND, who has been sales engineer with the U. S. Ball Bearing Mfg. Co., Chicago, Ill., for a number of years, has been made manager of the Cleveland office, with headquarters at 533 Leader-News Bldg.

G. E. SCHULTZ, formerly with the Industrial Department of the Westinghouse Electric & Mfg. Co., East Pittsburg, Pa., has been made manager of Russell, Holbrook & Henderson, Inc., 30 Church St., New York City.

R. M. LITTLE has been appointed successor to Arthur H. Young as director of the American Museum of Safety. Mr. Little was formerly a trustee of the museum, and is a man thoroughly versed in sociological work.

J. M. WILSON, formerly editor-in-chief of *Canadian Machinery* and allied publications of the McLean Publishing Co., Ltd., Toronto, Canada, is now on the engineering staff of the Standard Parts Co., Inc., Cleveland, Ohio.

LEWIS RUSSELL, president and general manager of Russell, Holbrook & Henderson, Inc., 30 Church St., New York City, has given up his position as general manager to join the Ordnance Department of the United States Army.

J. C. MANTERNACH has resigned his position as manager of the Standard Parts Co., Rim and Tube Division, to become president and general manager of the American Welding & Mfg. Co., Warren, Ohio, specialist in electric welded steel bands.

SIDNEY J. WILLIAMS has resigned his position as engineer to the Industrial Commission of Wisconsin to become manager of the Accident Prevention Division of the National Safety Council with headquarters in the Continental and Commercial Bank Bldg., Chicago, Ill.

W. A. HAINES has been appointed district representative at Detroit of the Automobile Equipment Department of the Westinghouse Electric & Mfg. Co., East Pittsburg, Pa. Mr. Haines has been assistant district manager of that department of the company for several years.

H. F. J. PORTER, industrial engineer, 200 Fifth Ave., New York City, is visiting the plants of the Hercules Powder Co., throughout the Middle West and out to the Pacific coast for the purpose of instituting such methods as may better labor conditions and increase efficiency in production.

A. NIEDERMEYER, for many years connected with the Worthington Pump & Machinery Corporation, 115 Broadway, New York City, recently as works manager of the Snow-Holly Works of that corporation at Buffalo, N. Y., has resigned his position and will devote his entire time to enterprises of his own.

P. B. FINDLEY, technical editor in the Department of Publicity, Westinghouse Electric & Mfg. Co., East Pittsburg, Pa., has entered the training school at the University of Pittsburg to take a special course in radio work with the Signal Corps. Before his connection with the Westinghouse Electric & Mfg. Co., Mr. Findley was editor of the *Electrical Age*.

A. B. COLE has been appointed assistant to the manager of the Department of Publicity, Westinghouse Electric & Mfg. Co., East Pittsburg, Pa., to succeed M. C. Turpin, who is now in the Ordnance Department at Washington, D. C. Mr. Cole will have charge of the editorial work, including preparation of advertising literature and supplying information to the press.

L. C. SPRAGUE has been appointed special representative of the Chicago Pneumatic Tool Co., Chicago, Ill., in connection with the sale of pneumatic tools to railroads. Mr. Sprague was formerly connected with the Railroad Department of the H. W. Johns-Manville Co., of New York City. His long association with the railroads of this country especially fits him for the work that has been assigned to him.

ARTHUR H. YOUNG, director of the American Museum of Safety since January 1, 1917, has resigned to take charge of the Employe Relations Department of the International Harvester Co., and will take up his new duties immediately. Although giving up the actual direction of the museum's work, Mr. Young will continue to be closely concerned with its affairs, as he has been elected vice-president to succeed the late Dr. Frederick R. Hutton. In recognition of Mr. Young's activities as chief safety expert of the Federal Government, the museum awarded him the Louis Livingston Seaman medal.

J. K. JENSEN, of the Department of Defence, Melbourne, Australia, expects to spend some time in the United States on his way to England, in connection with the establishment of a Government arsenal in Australia. While in the United States, he will collect information relating to plants used in the manufacture of all classes of war munitions. Mr. Jensen wishes to receive catalogues and information regarding all classes of machinery equipment and tools suitable for the production of guns, ammunition, small arms, trucks, airplanes, as well as general factory equipment. His address in New York City will be: J. K. Jensen, care of Australian Customs Representative, South Ferry Buildings, 44 Whitehall St., New York City.

OBITUARIES

HUGH HANNAN, head of the Hannan-Finton Co., of Springfield, Mass., machinery dealer, died at his home in Springfield June 17. Mr. Hannan went to Springfield about fifty-one years ago and about a year and a half later he started to learn the machinist's trade with Russell & Day. In 1883, he went into business for himself, and ten years later formed the Hannan-Finton Co. He leaves a widow and three daughters.

H. A. STOCKER, president of Stocker-Rumely-Wachs Co., of Chicago, dealer in machine tools, died at his home near Chicago on July 3, at the age of fifty-four. In 1895, Mr. Stocker organized the McDowell-Stocker Co., but sold his interest in this company in 1904 and formed, in 1905, the H. A. Stocker Machinery Co., which, in 1917, was combined with other interests, the Stocker-Rumely-Wachs Co. being formed. He was also a director of the Long & Allstatter Co., Hamilton, Ohio, and was interested in the Liberty Machine Tool Co., Hamilton, Ohio, the Massillon Foundry & Machine Co., Massillon, Ohio, and the Rockford Tool Co., Rockford, Ill.

COMING EVENTS

August 29—Monthly meeting of the Rochester Society of Technical Draftsmen, in Rooms 131-137, Sibley Block, 329 Main St., E., Rochester, N. Y. O. L. Angevine, Jr., secretary, 857 Genesee St., Rochester.

September 10—Twenty-sixth annual convention of the Traveling Engineers' Association, in Chicago, Ill. Secretary, W. O. Thompson, General Offices, New York Central Railroad, Cleveland, Ohio.

October 7-12—Joint convention of the American Foundrymen's Association and the American Institute of Metals in Milwaukee, Wis. Concurrent with these meetings there will be an exhibition of foundry equipment, machine tools, and accessories.

NEW BOOKS AND PAMPHLETS

Complete List of Base Prices, Differentials, and Extras on Iron, Steel, and Non-ferrous Products. 75 pages, 6 by 8¼ inches. Published by the Penton Publishing Co., Cleveland, Ohio. Price, $1.

This pamphlet contains a complete schedule of maximum prices on iron, steel, and non-ferrous products, as fixed by the Government through the recommendation of the American Iron and Steel Institute. There have been such numerous changes in prices during the past six months that previous price manuals have been rendered practically obsolete. This booklet has been brought up to date, including June, 1918.

A Handbook for Apprenticed Machinists. Edited by Oscar J. Beale. 144 pages, 4¼ by 6 inches; 87 illustrations. Published by Brown & Sharpe Mfg. Co., Providence, R. I. Price, 55 cents.

This is the third edition of this book, which is for learners in the use of machine tools and is the outgrowth of the needs of the Brown & Sharpe Mfg. Co. in the teaching of apprentices. Its aim is to teach those points in the use of machine tools that are more matters of knowledge than of skill. It does not aim to take the place of an engineer's handbook. The twelve chapters into which the book is divided are headed as follows: Care of Machines, Tools, and Work; Centering and Care of Centers; Turning, Reading Drawings, Measuring, Lacing Belts; Signs and Formulas; Drilling, Counterboring, Tapping, Cutting Speeds; The Screw and Its Parts; Figuring Gear Speeds, Figuring Pulley Speeds; Change-gears for Screw Cutting; Angles, Setting a Protractor, Working to an Angle; Circular Indexing, Straight-line Indexing; Subdividing a Thread; Later Points, Cautionary, Conclusion.

Essentials of Sheet Metal Work and Pattern Drafting. By James S. Daugherty. 181 pages, 5 by 7 inches. Published by Frederick J. Drake & Co., Chicago, Ill. Also obtainable from the Peck, Stow & Wilcox Co., Southington, Conn. Price, $1.50.

This book is an elementary and advanced course for the vocational and trade school students and apprentices, and is also intended for sheet metal workers in general, contractors, and teachers and instructors in trade schools. The author, being himself instructor in sheet metal work at the School of Applied Industries, Carnegie Institute of Technology, Pittsburg, Pa., has had a wide experience in the teaching of the subject on which he has prepared a treatise. It will be found of value to sheet metal workers of all kinds. The book was written in answer to numerous requests for information regarding courses in sheet metal work, suitable for trade and manual high schools. It is divided into fifteen chapters as follows: Transferring Patterns to Metal; Cutting Patterns and Templets; Folding Edges and Seaming; Forming, Grooving, Beading, and Crimping; Soldering; Double Hemmed Edge; Wiring Process; Notching and Burring; Double Seaming, Peening, and Raising; Radial Line Developments; Pitched Covers and Flaring

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A Few Secrets of the Metallurgist Simply Told. By Gerald W. Hinkley. 99 pages, 5 by 7 inches. Published by the Atlas Crucible Steel Co., Dunkirk, N. Y.

The author of this book, a mechanical engineer, who is assistant to the president of the Atlas Crucible Steel Co., has presented in this book a brief outline of a few of the main and most important principles of metallurgy written primarily for the layman. In preparing the work, the author has used his experience and personal observations in the metallurgical laboratory, and has also availed himself of the accumulated information available in the works of many eminent metallurgists. Where opinions differ on metallurgical principles, as is frequently the case, he has attempted to adopt the most logical consensus of opinion. The book should be of interest to all who have to deal with steel, and particularly to those who have to do with its heat-treatment. It deals first with the elementary principles involved in the metallurgy of steel, both carbon and high-speed steel, and then specifically, with the general effect of the more important elements in both steels, after which sections are devoted to the heat-treatment of steel—hardening, annealing, and tempering. An interesting chapter is entitled "What Tool Steel is doing toward Winning the War," and an appendix is added, giving the analysis, uses, and heat-treatment of various grades of tool steels.

Sheet Metal Workers' Manual. By L. Broemel and J. S. Daugherty. 552 pages, 5 by 7 inches. Published by Frederick J. Drake & Co., Chicago, Ill. Also obtainable from Peck, Stow & Wilcox Co., Southington, Conn. Price, $2.

This book may be defined as a practical instruction book on the sheet metal industry and the machinery and tools used in it, and includes information on the subject of oxy-acetylene welding and cutting, as practiced in sheet metal work. It also contains a special course in elementary and advanced sheet metal work and pattern drafting for technical and trade school instructors and students, this course being also intended for sheet metal workers and apprentices in the sheet metal trades. The principal author of this book has been for many years active with the Peck, Stow & Wilcox Co. of Southington, Conn., manufacturer of sheet metal working machinery, and hence is in a position to present an authoritative collection of data on the construction and application of modern sheet metal working machines and tools. Besides the practical treatise on the subject given by Mr. Broemel, the correlated course in sheet metal and pattern drafting prepared by Professor Daugherty, who is instructor in sheet metal work in the School of Applied Industries, Carnegie Institute of Technology, Pittsburg, Pa., adds greatly to the value of the work. The course is presented in such sequence that processes and machine operations are reviewed with each new problem. The book will be found of value to men in the sheet metal trade, and the information contained will save time and labor and aid in the solving of the many problems that daily confront the sheet metal worker. It is divided into chapters as follows: The Sheet Metal Industry; Sheet Metal Working Machinery; Sheet Metal Working Tools; Sheet Metal Working School Shop Equipment; Course in Elementary and Advanced Sheet Metal Work and Pattern Drafting; Outline Course in Sheet Metal Works—Emergency War Training; Oxy-Acetylene Welding and Cutting; Electric Welding; Hand Forging and Welding—Course in Forge Practice; Outline Course in Hand Forging and Welding—Emergency War Training; Brazing; Pipe Bending; Properties of Metals and Their Alloys; Practical Geometry and Mensuration; Useful Tables. The headings of these various chapters will indicate to the man engaged in the sheet metal trade the comprehensive field covered by the book more than would any other method of reviewing its contents.

NEW CATALOGUES AND CIRCULARS

General Electric Co., Schenectady, N. Y. Circular descriptive of Type IL series transformers for street lighting service.

Westinghouse Electric & Mfg. Co., East Pittsburg, Pa. Circular 7150 of Westinghouse electrical equipment for garment manufacturers.

Smith-Serrell Co., Inc., 144 Cedar St., New York City. Bulletin 26, with new price lists of Francke flexible couplings of the heavy-pattern type.

Worthington Pump & Machinery Corporation, 115 Broadway, New York City. Circular D-702, descriptive of vertical triplex single- and double-acting power pumps.

Loshbough-Jordan Tool & Machine Co., Elkhart, Ind. Circular giving specifications for the Loshbough-Jordan flywheel presses and combination geared presses.

Bolinder's Co., 30 Church St., New York City. Circular illustrating installations of Bolinder's heavy oil engines in full-powered and auxiliary ships.

Sprague Electric Works of General Electric Co., 527 W. 34th St., New York City. Circular of Sprague flexible steel armored cables of the S.S. type.

Wilson-Maeulen Co., 781 E. 142nd St., New York City. Catalogue describing and giving specifications for Wilson-Maeulen pyrometers and auxiliary apparatus.

All-American Truck Co., Sacramento Blvd. and Chicago and Grand Aves., Chicago, Ill. Circular advertising All-American kerosene-burning, standard one-ton trucks.

Albro-Clem Elevator Co., 501 Erie Ave., E., Philadelphia, Pa. Circular outlining the advantages that can be obtained through the use of the Hindley worm-gear drive.

Edwin E. Bartlett, Nashua, N. H. Catalogue N, showing the various sizes and types of "Greenerd" arbor presses. A table is included giving essential data for these presses.

St. Louis Machine Tool Co., 932 Loughborough Ave., St. Louis, Mo. Circular of St. Louis polishing machines and "Western" grinders, giving specifications for the various sizes.

Ohio Electric & Controller Co., 5900 Maurice Ave., Cleveland, Ohio. Bulletin 101, giving dimensions, capacity, current required, and other essential data for Ohio mill type lifting magnets.

National Tube Co., Frick Bldg., Pittsburg, Pa. Circular entitled "Service Every Minute," showing illustrations of National pipe that has been in use for many years, indicating its durability.

National Tube Co., Frick Bldg., Pittsburg, Pa. Circular entitled "Twenty-eight Years of Steel 'National' Pipe Progress," showing the progress that has been made in the production of steel pipe.

General Electric Co., Schenectady, N. Y. Bulletin 48024, entitled "Electricity in the Cane Sugar Industry," describing the advantages derived from the application of electrical apparatus in cane sugar mills.

Barnes & Irving, Inc., Grand Opera House Block, Syracuse, N. Y. Circular of Misener expanding rotary hacksaw for cutting circular holes in metal, wood, slate, marble, etc. This hacksaw will cut pipe sizes from ¾ inch to 4 inches in diameter.

Cutler-Hammer Mfg. Co., Milwaukee, Wis. Bulletin 259 of safety starting switch for alternating-current squirrel-cage motors. A blueprint is circulated with the bulletin giving dimensions for the two sizes of enclosed safety starter, together with the connection diagram.

Asa S. Cook Co., Hartford, Conn. Catalogue giving specifications for die-headers, shaving and slotting machines, threading and pointing machines, shaver and threader tool grinders, shaker machines, pointing machines, slotting machines, die threading machines, and lag screw threading machines.

Gisholt Machine Co., Madison, Wis. Catalogue entitled "Motor Trucks in the War," containing many illustrations showing the varied uses of motor trucks on war work, as well as illustrations of the Gisholt turret lathe, which is used in manufacturing some of the mechanical parts for these trucks.

Emmert Mfg. Co., Waynesboro, Pa. Catalogue printed in colors, treating of Emmert vertical and horizontal T-squares and drawing boards. These T-squares are designed to effect a saving in time and labor, and to provide an outfit which will enable the draftsman to make full-size drawings while sitting or standing in a normal or healthful position.

Cincinnati Milling Machine Co. and Modern Foundry Co., Cincinnati, Ohio. Pamphlet entitled "Over the Top," containing an account of the activities of these companies and their employes in the Third Liberty Loan campaign and the results of their work. The pamphlet shows views in the various departments illustrating the decorations that were arranged by the employes.

Bastian-Blessing Co., W. Austin Ave. at La Salle St., Chicago, Ill. Catalogue of "Rego" welding and cutting apparatus, lead burning equipment, regulators, etc. Specifications for complete cutting and welding units are given, followed by detailed descriptions of the regulators and torches. It is claimed that these torches are so made that flash-back has been entirely eliminated.

American Chemical Paint Co., Liberty Bldg., Philadelphia, Pa. Booklet entitled "The Art of Preparing Steel for Painting," descriptive of the "Deoxidine" patented process for cleaning steel and for preventing its rusting after paint has been applied to the surface. The booklet contains directions both for rustproofing and for cleaning iron and steel surfaces with "Deoxidine," and describes the process in detail.

Leeds & Northrup Co., 4901 Stenton Ave., Philadelphia, Pa. Catalogue 87, entitled "The Potentiometer System of Pyrometry and Temperature Control," describing a system of pyrometry and temperature control in which the potentiometer method is employed for measuring the electromotive force of thermo-couples. The potentiometer is also applied to a special apparatus for the location of the thermal transformation or recalescence and decalescence points of metals.

Brown Instrument Co., Philadelphia, Pa., is circulating a color chart showing the melting points of chemical elements in degrees Centigrade and Fahrenheit, and the heat colors at different temperatures. The color scale, which is printed in four colors and gives heat colors for fifty elements, should be found valuable in heat-treating work. On the other side of the chart is printed a conversion table of Fahrenheit and Centigrade scales. The card is provided with a cord and hook so that it can be hung up for ready reference. A chart will be sent free to anyone interested.

Plymouth Cordage Co., North Plymouth, Mass. Catalogue entitled "The Story of Rope," treating of the history and modern development of rope-making, with particular reference to the practice of this company. The book is divided into three parts, Part I dealing with the history of the industry, Part II with the raw materials, and Part III with present-day manufacturing processes, methods, and equipment. The production of rope is described step by step, starting with the raw material in its natural state in the fields. The book contains many illustrations and is one that should be of considerable general interest.

Brown Instrument Co., Philadelphia, Pa. Catalogue 11, showing the complete line of Brown indicating and recording pyrometers. The catalogue illustrates high-resistance pyrometers having an internal resistance of from 600 to 1000 ohms. A number of new instruments are shown, among which are a new precision heatmeter and a transformation point pyrometer which determines the transformation points of steel. Various types of platinum and base-metal thermo-couples and protecting tubes are described at length, and suggestions are given for the installation of couples. A copy of the catalogue will be sent free upon request.

Swedish Chamber of Commerce of the U. S. A., Produce Exchange Annex, New York City. Book entitled "Sweden-America," published with the view of interesting American business men in trade with Sweden and to acquaint them with the industries and development of that country. The book, in addition, contains a number of interesting general articles; one that will be of special interest to the machine trade is entitled "American Machines in Sweden." It is stated that America will be able to compete successfully with other countries after the war if proper efforts are made, but that a preparation to forestall competitors after the war is necessary. The book is well printed and has a pleasing typographical appearance.

TRADE NOTES

Economy Drawing Table Co., Adrian, Mich., has increased its capital stock to $150,000. The company has large government contracts, and reports a heavy demand for its tables.

Fulflo Pump Co., Blanchester, Ohio, is erecting two additions to its foundry, consisting of a one-story sand-handling and cleaning room, 48 by 80 feet, and a molding floor, 35 by 80 feet.

Chicago Tool Reclaiming Co., 149 W. Austin Ave., Chicago, Ill., has been organized by H. H. Hartman and F. W. Anderson. The company will specialize in the reclaiming of high-speed milling cutters of all kinds, as well as end-mills, etc. The process of reclaiming employed makes it unnecessary to anneal the tools.

High Speed Hammer Co., Rochester, N. Y., has moved into its new plant at 313 Norton St., which is a one-story brick and concrete building with sawtooth roof construction. The new factory will afford double the former floor space and will facilitate the production of the company's line of riveting and drilling machines.

Union Switch & Signal Co., Swissvale, Pa., has recently installed two 6000-pound, two 3000-pound, and one 2000-pound steam drop-hammers, which makes a total equipment of twelve steam drop and shaping hammers and eighteen board drop-hammers. Plans for the extension of the die room and increased facilities for heat-treating are being made.

Cleveland Milling Machine Co., Cleveland, Ohio, manufacturer of milling machines, cutter grinders, and milling cutters, is constructing a two-story brick office building to take care of the increase in the company's business. This building is a further addition to the three-story building which has recently been erected for taking care of the milling cutter manufacturing department.

Youroveta Home & Foreign Trade Co., Inc., New York office, 120 Broadway; principal office, Petrograd, Russia, a well-known and thoroughly established Russian company, is now making agency arrangements for the sale of machine tools and small tools in Russia after the war, and immediately in the Far East. A. M. Peskine, well known to MACHINERY and to the machine tool trade in this country, is manager of the machine tool department.

Schoen-Jackson Co., Finance Bldg., South Penn Square, Philadelphia, Pa., and the **Southwark Bronze Co.**, Water and Mifflin Sts., Philadelphia, Pa., have been consolidated under the corporate name of Schoen-Jackson Co. The consolidated company will continue the business carried on by both companies, and owing to its increased resources and facilities it is believed that it will be in a better condition than ever to handle all business in its line that may be offered it.

Standard Pressed Steel Co., Philadelphia, Pa., manufacturer of "Pioneer" steel shaft hangers, "Hallowell" cold-rolled steel shaft collars, and "Standco" hollow safety set-screws, announces that the company has found it necessary to move its general offices and business departments to 20th St. and Indiana Ave., Philadelphia, Pa., in order to take care of the increase in the demand for its products. In the new location, the company will be able to take care of the rapidly expanding business and to give its customers prompt and efficient attention.

American Bronze Corporation, Berwyn, Pa., maker of "Non-gran" bearing bronze, announces that, owing to the great increase in the demand for the company's products, a large addition to the works has been constructed by Crowell, Lundoff & Little, of Cleveland, Ohio. The plant is of the latest type of fireproof construction and will triple the present capacity of the company by September 1. The new buildings have been carefully planned for high efficiency of production; the material moves by the shortest routes from the receiving stores department to the shipping department.

Doehler Die-casting Co., Court, Ninth, and Huntington Sts., Brooklyn, N. Y., has recently broken ground for a new addition to its factory, which will cover 150 feet on Court St. and 200 on Huntington St. The new building will be ten stories high and will be of steel and concrete construction throughout, to conform with the general character of the present structure, the latest addition to which was completed about September 1. New types of automatic die-casting machinery are now in process of construction and will be installed in the new building. The addition will double the present capacity of the plant.

AUGUST 1918

MACHINERY

VOL. 24 NO. 12



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Safe Chain Loads—Factors that Determine Safe Loads, and Effects Obtained by Annealing Chain. By A. Black.

Critical Speeds in Tapered Shaft Design—Derivation of Formulas and Examples Illustrating their Use. By Alfred Musso.

Hollings Indenting Type of Nut-forging Machine—A Machine which, in Conjunction with the Special Bar Stock Used, makes it Possible to Produce Well-formed Blanks without Excessive Pressure and with a Relatively Small Amount of Scrap.

Making the Mark III Detonating Fuse—First Article Ever Published on This New Fuse. By Edward K. Hammond.

Dies for Tape-measure Winder—Description of Interesting Development in Die Design.

THE INDUSTRIAL PRESS, Publishers, 140-148 Lafayette Street, New York, N. Y.

PUBLISHED MONTHLY. YEARLY SUBSCRIPTION, $2; CANADA, $3; FOREIGN COUNTRIES, $5. ENTERED AS SECOND-CLASS MAIL MATTER, SEPTEMBER, 1894, AT THE POST OFFICE OF NEW YORK, N. Y., UNDER THE ACT OF MARCH 3, 1879

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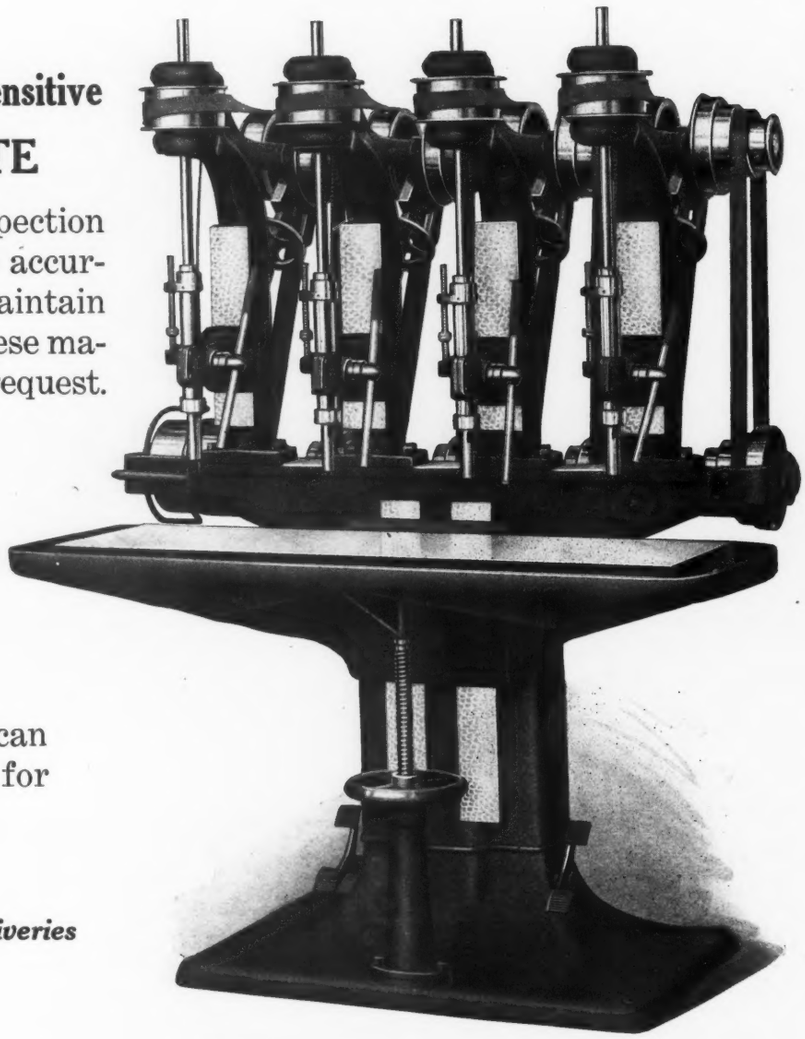
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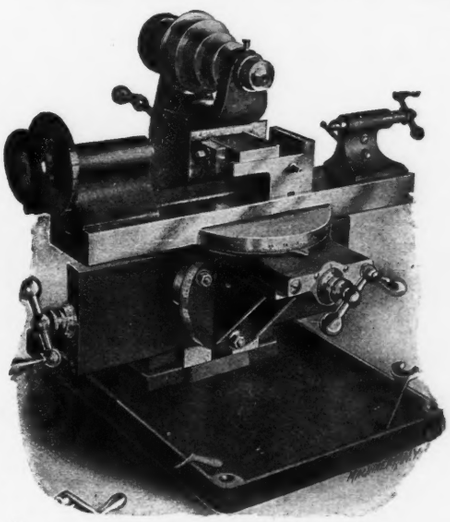


SNYDER UPRIGHT DRILLS
Are Being Bought by the World's Markets

Our Upright Drills need no introduction, as they have been in use for the past "thirty years." They are furnished for motor drive, either gear or belt connected. Also with compound table, and with tapping attachment. These drills are especially adapted to long boring purposes, where others fail to do the job.

J. E. SNYDER & SON Worcester, Mass., U. S. A.

THE SLOAN & CHACE BENCH MILLING MACHINE



This Bench Milling Machine is economical, and a space saver, with an almost universal adaptability. Designed for tool room and experimental work, it is also valuable in light manufacturing. The spindle of this machine is interchangeable with the spindle of our No. 5½ Bench Lathe—which permits transfer of work without change of setting.

Independent screw feed, accurately fitted tail stock, feed screws with dials graduated to read in thousandths, perfect alignment—all these points and many others make this miller a permanent economy in the shop.

Details of this and other precision machines in our catalogue

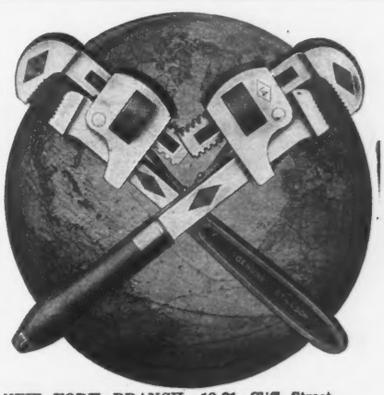
SLOAN & CHACE MANUFACTURING COMPANY, Ltd.
6th Avenue and N. 13th Street NEWARK, N. J.

WALWORTH "STILLSON"

One of a Famous Trio

The Walworth Genuine Stillson Wrench, in construction and operation, is ideal. As a unit of the famous Walworth Trio it has an added value. Each of these three wrenches has a distinctive purpose; together they serve all purposes. Put the Walworth Parmelee and the Walco Hex alongside your Walworth Stillson. Shall we send circular?

WALWORTH MFG. COMPANY
BOSTON, MASSACHUSETTS, U. S. A.
Makers of
The Walworth Genuine Stillson Wrench



NEW YORK BRANCH, 19-21 Cliff Street.
CHICAGO BRANCH, 218-222 N. Desplaines St.
SEATTLE, WASH., 414 First Ave., South.

MACHINE

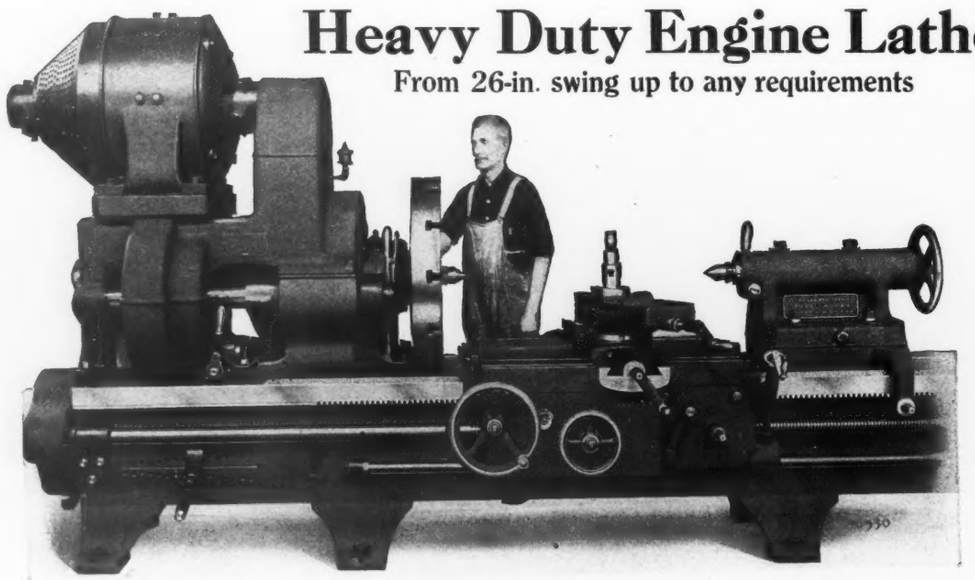
NILES-BEMENT-POND

Machine Tools, Steam Hammers, Traveling Cranes

We are in a particularly favorable position to furnish complete machine tool equipment for a general machine shop, railroad shop, shipyard, heavy ordnance or small arms arsenal.

Heavy Duty Engine Lathes

From 26-in. swing up to any requirements



30-inch Double Geared Engine Lathe

NILES-BEMENT-

GENERAL OFFICES:

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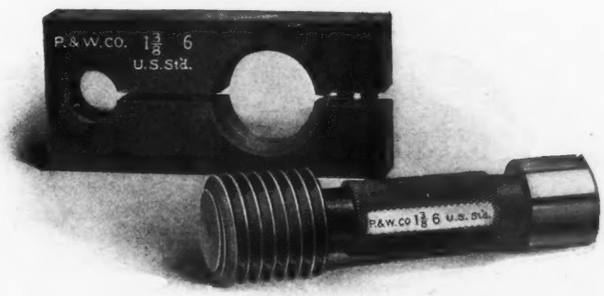
TOOLS

PRATT & WHITNEY

Precision Machine Tools, Small Tools, Standards and Gauges

For more than fifty years the Pratt & Whitney Company has been developing a line of Precision Machine Tools, Gauges and Small Tools, the predominating characteristics of which have always been accuracy and refinement.

U. S. Standard Thread Gauges



The exceptional merit of the United States Standard Thread System has long been acknowledged, and the importance of its general adoption has been persistently urged by the engineering profession. Its universal adoption as the standard for all government work in the United States and the Continental European countries, also by all railroads and practically all the other manufacturing industries in the United States, is largely due to the fact that it is the only form of thread by which interchangeability in manufacturing is possible.

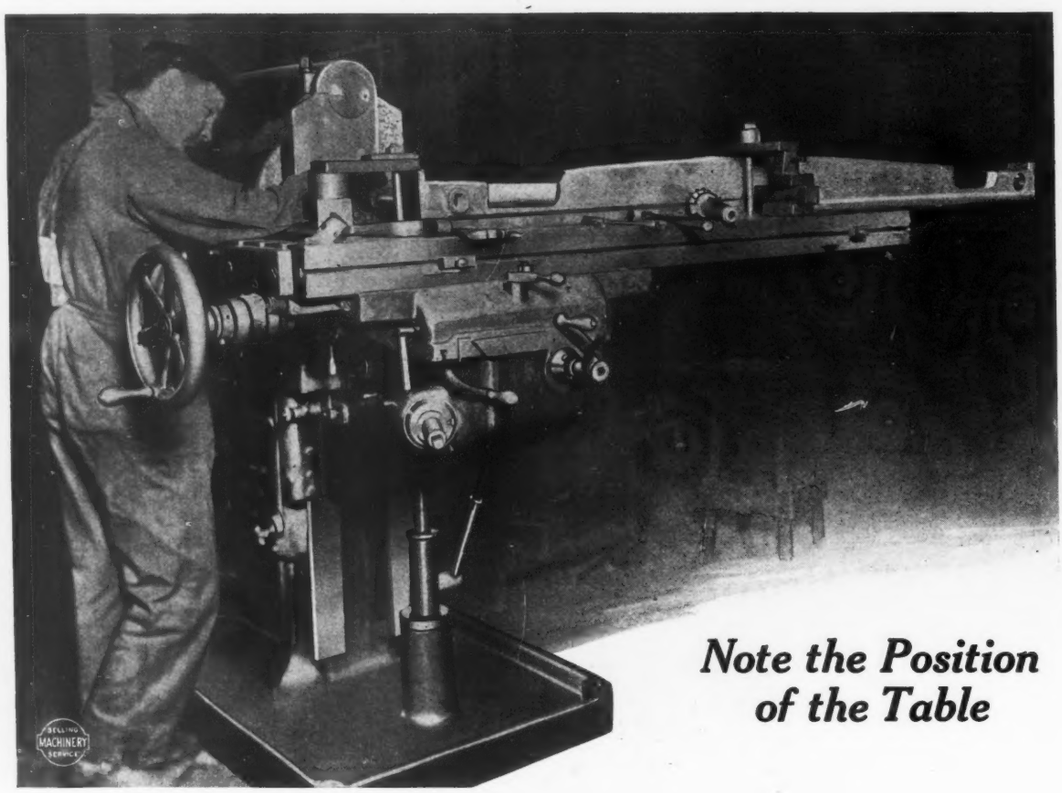
Write for a copy of our Catalog "Standards and Gauges"

POND COMPANY

111 BROADWAY, NEW YORK

Birmingham, Ala.: 2015 First Ave. **San Francisco:** 16 to 18 Fremont St. **London, Eng.:** 25 Victoria St., S. W. **For Colorado, Utah, Wyoming and New Mexico:** Hendrie & Bolthoff Manufacturing & Supply Co., Denver. **For Canada:** The John Bertram & Sons Co., Ltd., Dundas, Montreal, Toronto, Winnipeg and Vancouver.

Only a Rigid Machine Could Perform This Job



Note the Position of the Table

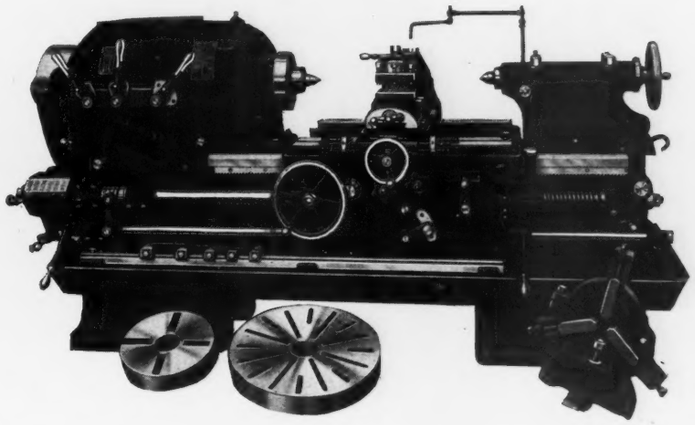
The work is a jeweler's draw bench. The operation, boring holes at each end of the casting, is one of extreme accuracy. Ordinarily the weight of the piece and the fact that it is necessary to use the table at the extreme end of its travel would be against accuracy. This makes no difference on the Milwaukee Milling Machine, however, on account of its rigidity.

The W. W. Oliver Manufacturing Company, Buffalo, N. Y., has used this machine on special manufacturing of a wide range for many years; when photographed recently on this particularly trying job it was working with original accuracy unimpaired. Accuracy in the work means rigidity in the machine. Both rigidity and accuracy are embodied in Milwaukee Milling Machines.

MILWAUKEE MILLING MACHINES

Let us tell you about Milwaukee construction in detail

KEARNEY & TRECKER CO., MILWAUKEE, WIS., U.S.A.



Conserve Your Workmen's Energy

THE LODGE AND SHIPLEY MANUFACTURING LATHE measures the pieces. The operator sets the diameter and length stops as he turns the first piece. Then the stops accurately and easily duplicate the rest of the lot. The operator does not have to use his scale, calipers and micrometer on every piece.

Front and rear tool rests for high duty, four-way or gang tool blocks, provide for enough tools to finish the piece in one set up. Pan, pump and tubing keep the floor clean and get maximum service from the tool steel.

You should know more about how the Manufacturing Lathe will increase your lathe production. Write us now.

LATHES
Good Lathes Only

The Lodge & Shipley Machine Tool Co.
CINCINNATI, OHIO, U. S. A.

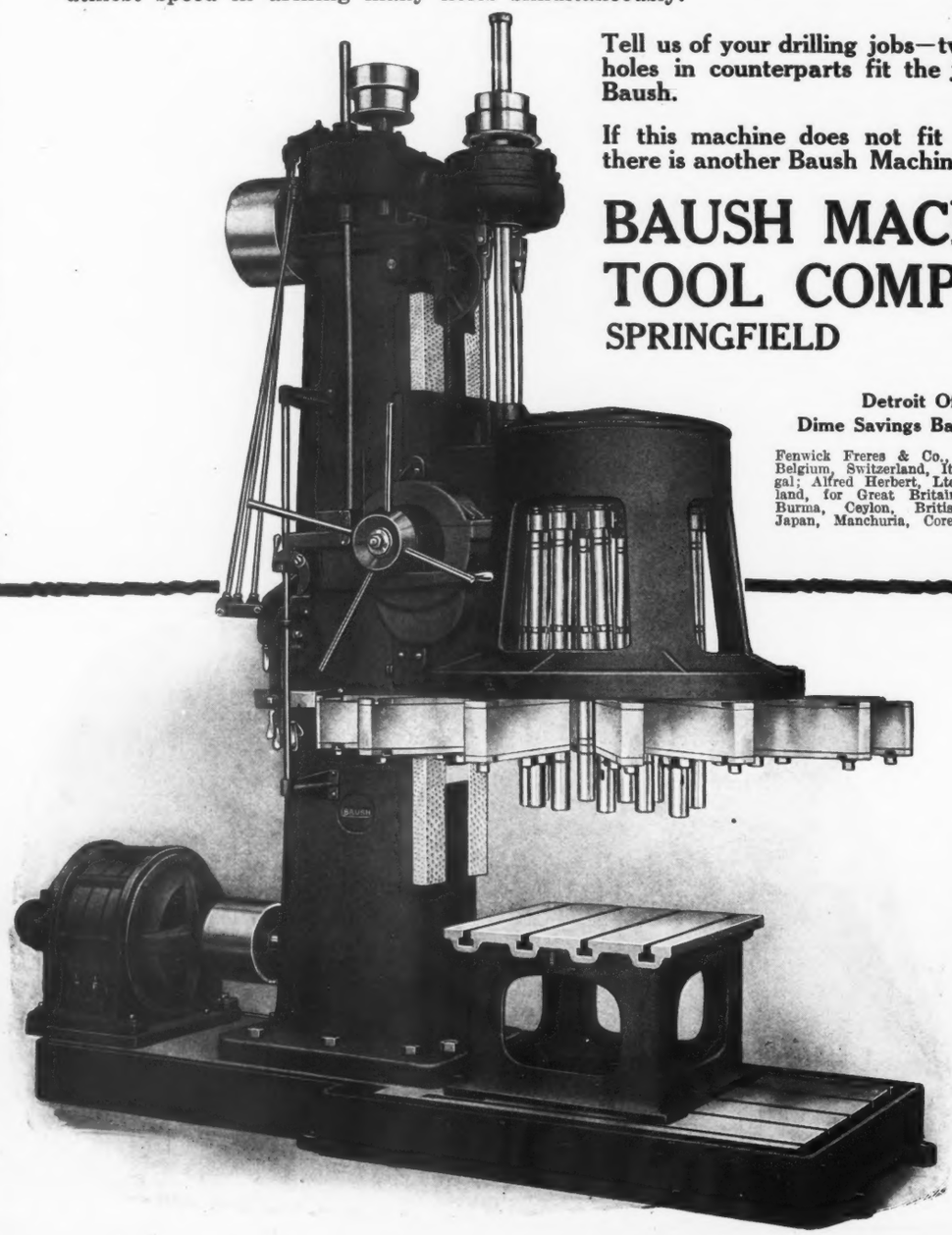
Baush High Speed Multiple Spindle Drill No. 4

This machine can be supplied with heads of various sizes, up to 30 inches round and 30 by 46 inches rectangular. It is capable of driving twelve 1¼-inch, sixteen 1-inch drills, etc., up to twenty-eight ⅝-inch drills in cast iron.

The drill spindles are adjustable over widely varying layouts, to suit the positioning of the holes in the work.

Convenience of operation has been considered in every detail of control. The belt shifter, the three speed changes and four feed changes are all at the instant command of the operator. The feed is provided with automatic trip; the head can be fed farther by hand if desired.

In fact, this Baush Multiple Spindle Drill has been designed throughout to secure the utmost speed in drilling many holes simultaneously.



Tell us of your drilling jobs—two or more holes in counterparts fit the job for the Baush.

If this machine does not fit your work there is another Baush Machine that will.

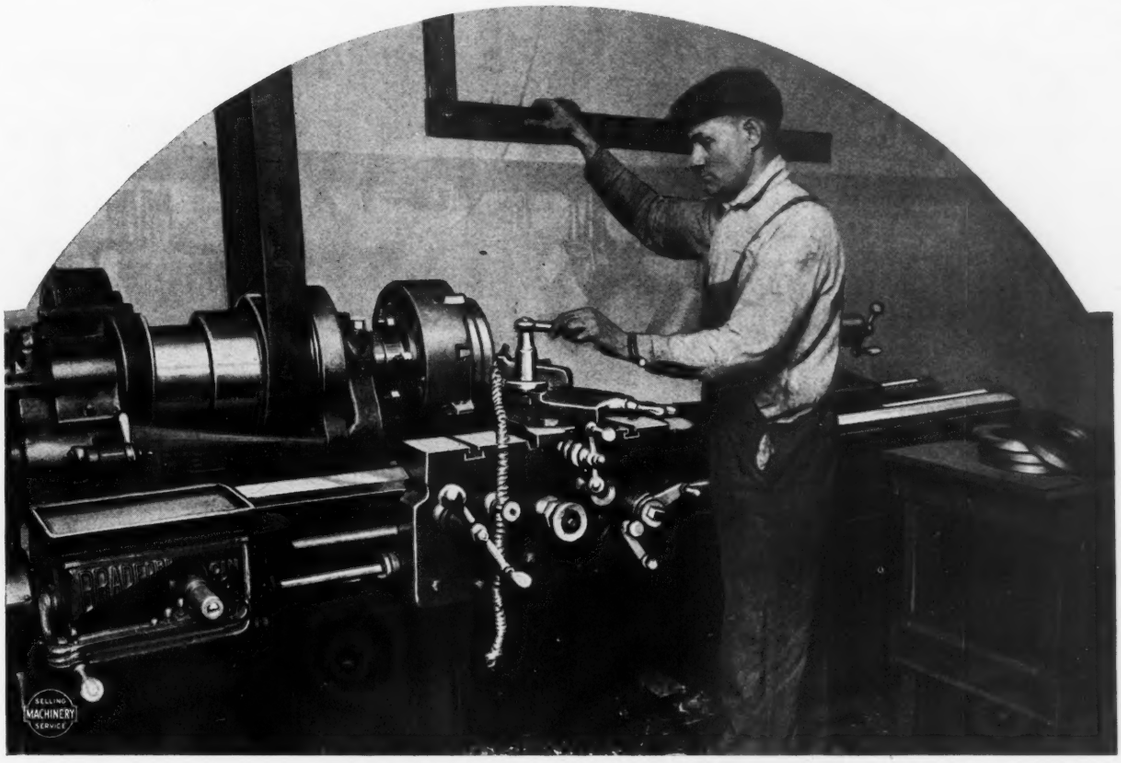
BAUSH MACHINE TOOL COMPANY

SPRINGFIELD MASS.

Detroit Office:
Dime Savings Bank Building

Fenwick Freres & Co., France, Holland, Belgium, Switzerland, Italy, Spain, Portugal; Alfred Herbert, Ltd., Coventry, England, for Great Britain, Ireland, India, Burma, Ceylon, British South Africa, Japan, Manchuria, Corea, Formosa.

BAUSH



Bradford Lathes

This Bradford Was Bought Before "Speed-Up" Became a By-Word—*But It Was Ready*

The Indianapolis Tool & Manufacturing Company of Indianapolis purchased this Bradford Lathe in 1910—long before the war demanded the supreme effort of machine tools. But the Bradford was ready. It was built to withstand unexpected strains, and after eight years of roughing out tough gear blanks, it is, not only in efficiency but even in appearance, the same *new* lathe it was the day it was installed.

It is the Bradford's ability to do the unusual that makes it so popular. Modern shop practice daily demands more rigid requirements. Are your machines prepared?

Bradford Lathes are made in sizes from 14" to 42" swing.
Get the catalog for full particulars

THE BRADFORD MACHINE TOOL CO.

CINCINNATI OHIO, U. S. A.

AGENTS: Swind Machinery Co., Philadelphia. Taylor Machinery Co., Boston, Mass. Stocker-Rumley-Wachs Co., Chicago, Ill. Somers, Fitler & Todd Co., Pittsburgh, Pa. The E. A. Kinsey Co., Cincinnati, O., and Indianapolis, Ind. The Mine & Smelter Supply Co., Denver, Colo. Pacific Tool & Supply Co., San Francisco, Cal.



Stewart
Soft Metal
Melting Furnace



Stewart No. 28
Bench Oven
Furnace



Stewart No. 1
Oven Furnace

Why Manufacturers Choose

STEWART FURNACES

Steel, fuel, tools and labor are higher to-day than ever before. When a piece of work is ready for heat treatment a considerable investment lies in the furnace, upon the correctness of which depends the profit on time and money already spent.

Careful manufacturers, for this reason, appreciate the importance of using the best furnaces obtainable. The same reason accounts for the wide adoption of Stewart Furnaces.

In Stewart Furnaces heavy linings effectively check radiation, and a quickly obtained temperature has permanent uniformity. Burners produce perfect combustion without smoke, soot or odor, thus making chimney connections unnecessary. Stewart Furnaces are clean, convenient and compact; durable, though simply constructed, and easy to operate.

Stewart Furnaces are adapted for artificial, producer or natural gas, fuel oil or kerosene. They are made in types and sizes to serve most purposes. Special sizes made to your own specifications.

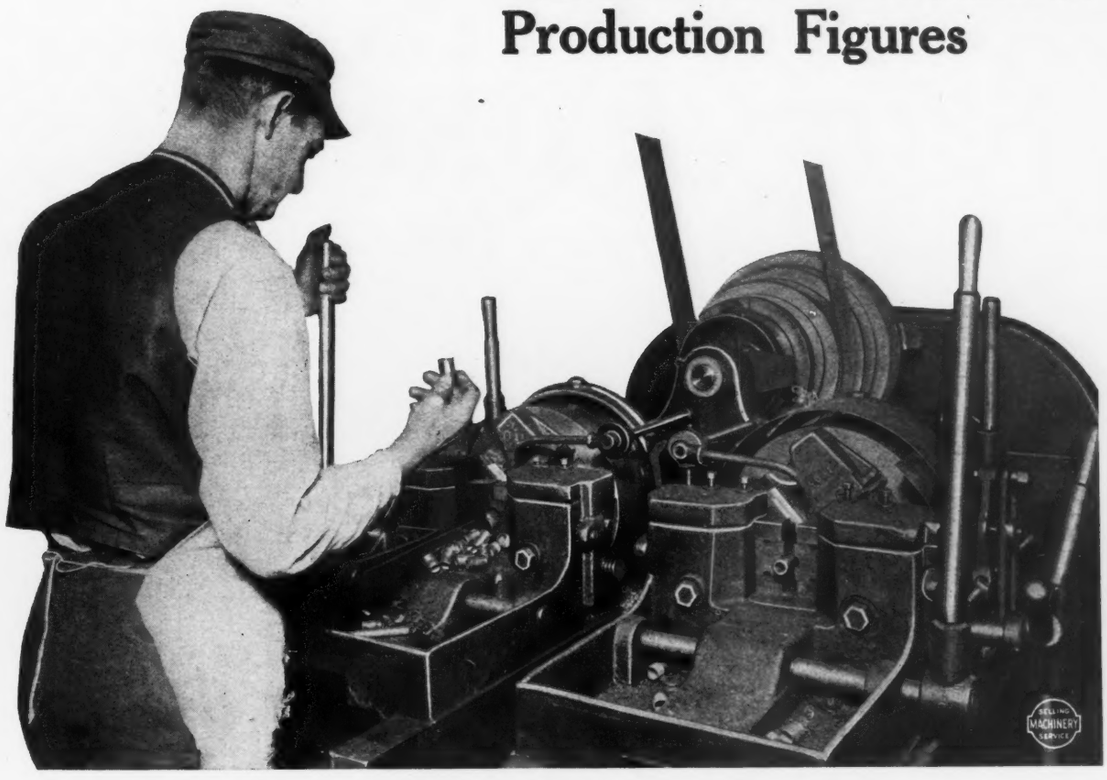
Let us send the complete catalogue and details of 30-day free trial offer.

CHICAGO FLEXIBLE SHAFT COMPANY

12th St. and Central Ave.

CHICAGO ILLINOIS, U. S. A.

The Richardson People Asked Us To Withhold Production Figures



But We Can Assure You Output Is—

Very Good Indeed

A Landis Double Head Threading Machine is always a cost cutter—whether on straightaway work or a two operation job such as the one photographed in the Edro Richardson Brass Company's plant. Work is ½ inch diameter brass nipples, threaded on both ends. For the first operation, nipples are held in the regular way and threaded for ¾ inch—half their length; but for threading the second end a threaded grip is used, which grips securely without damaging the threaded portion. Though we can't tell you just how good production is on this work, we can assure you it is highly satisfactory to all concerned.

Landis Double Head Machines save power and labor as well as time—points well worth considering in addition to the clean, accurate threads they cut. We make it our business to adapt them to every cutting problem within their range—how about yours?

LANDIS MACHINE COMPANY

WAYNESBORO **PENNSYLVANIA**

INCORPORATED



"The Dragon"

is a publication issued monthly by The Fafnir Bearing Co. in the interest of Ball Bearings and their correct application.

We shall be glad to send a copy of each issue to the manufacturer or engineer

Please send me a copy of each issue of "The Dragon."

Name.....

Position.....

Company.....

Address.....

70

THE FAFNIR BEARING COMPANY

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DETROIT Office
752 David Whitney Bldg.

New Britain, Conn.

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1919 So. Michigan Ave.

Beaman & Smith Engineers are Production Specialists

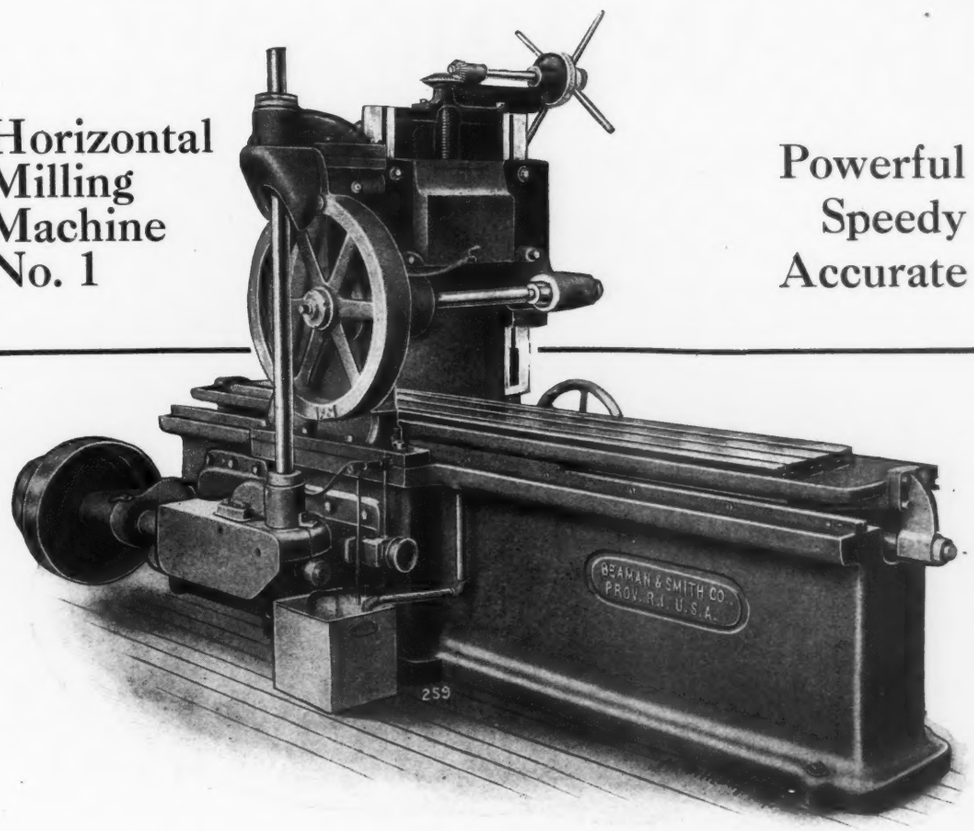
Their sole business is to design and build machines to perform any one operation or any series of operations better and faster than they have ever before been performed. The No. 1 Horizontal Milling Machine is one of the tools we have evolved. In this machine the arbor provides ample cutter space, the work surface is large, the drive powerful and dependable—for the quick removal of stock there isn't a more capable machine of its kind to be had. It's a wide range machine, too. It's one of a number of Beaman & Smith machines doing excellent work under conditions that test metal and build. We build machines for boring, milling, drilling, etc.; all sizes, all combinations; carry an efficient line of "regulars," and furnish special machines when these won't answer. Write us.

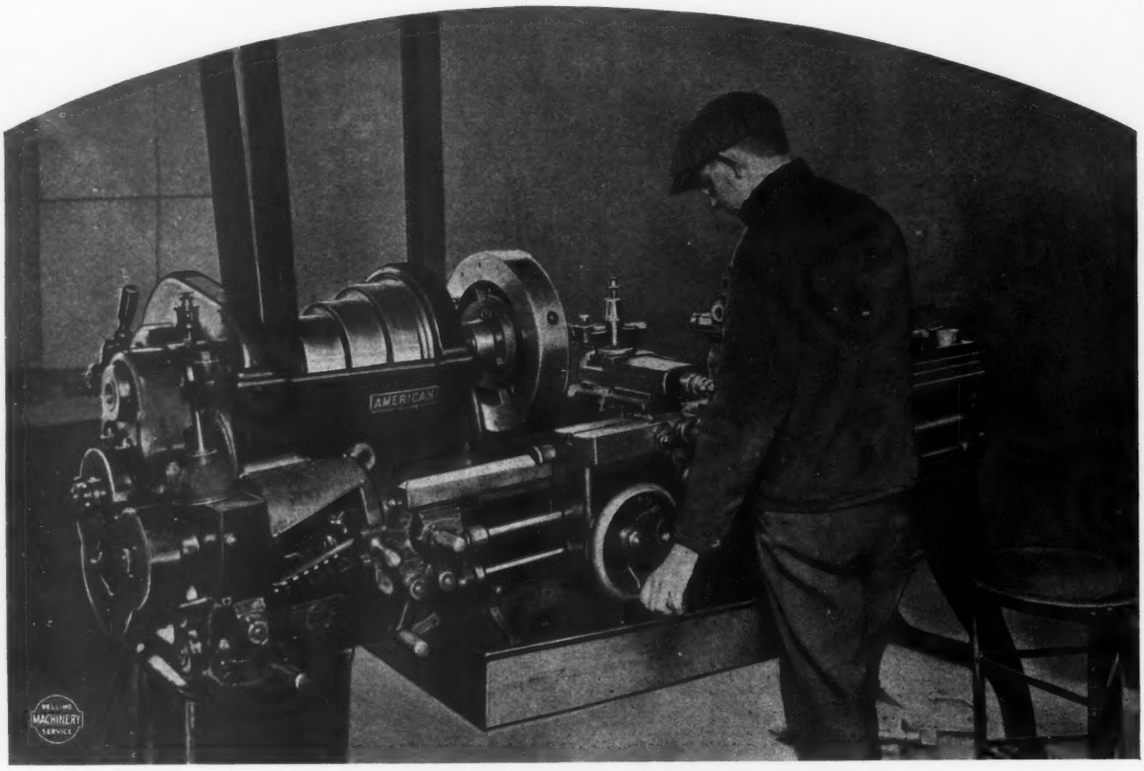
BEAMAN & SMITH COMPANY

PROVIDENCE RHODE ISLAND

Horizontal Milling Machine No. 1

Powerful
Speedy
Accurate





AMERICAN

The AMERICAN Lathe

As a Valuable Factor in Automobile Transmission Production

The Durston Gear Company, Syracuse, N. Y., makes automobile transmissions for high grade motor cars—and the American Tool Room Lathe makes jigs and fixtures and tools for the Durston Company. It takes no great stretch of the imagination to see the value of the lathe in the production of the gears—for to make good transmissions all machines and tools must be top-notch. And when we asked the toolroom foreman at Durston's about the "American" he said: "I like them. I have used them for toolroom work for over a year—on all kinds of heavy jig and fixture work. They meet every requirement for accuracy."

THE AMERICAN TOOL WORKS

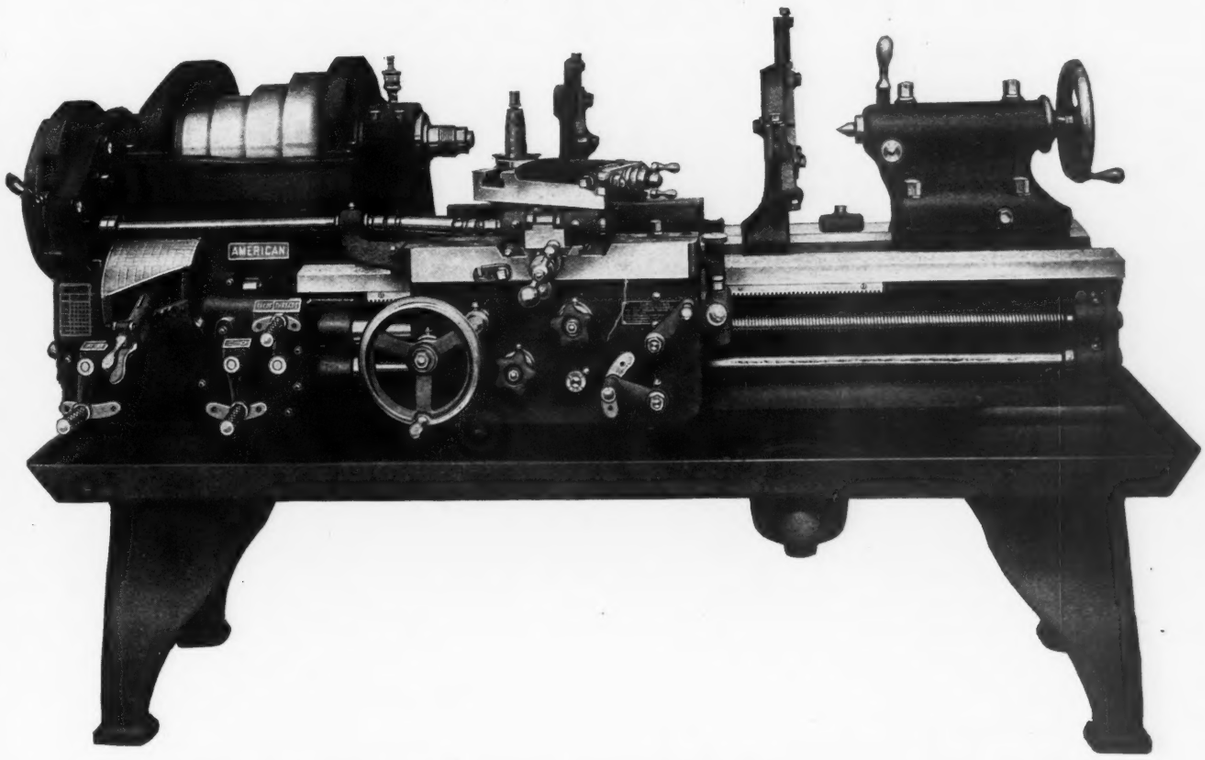
LATHES **PLANERS**

Progressive Tool Makers
Prefer the "American"

Where you find a progressive tool room the chances are you'll find "American" tool room lathes. "American" Quality is recognized and utilized by such people as the Ford Motor Company, General Electric, Brown & Sharpe, Winchester Repeating Arms, Pennsylvania R. R., Geometric Tool Company, Bausch & Lomb Optical Company and dozens more of the biggest and best concerns in the country.

There are good reasons why "American" lathes have the preference. Not only are they built to highest standards, but we have developed attachments for tool room along original lines and to close standards of accuracy—attachments which may be fitted when the lathe is purchased or added later on as occasion demands.

Let us tell you more about this machine.

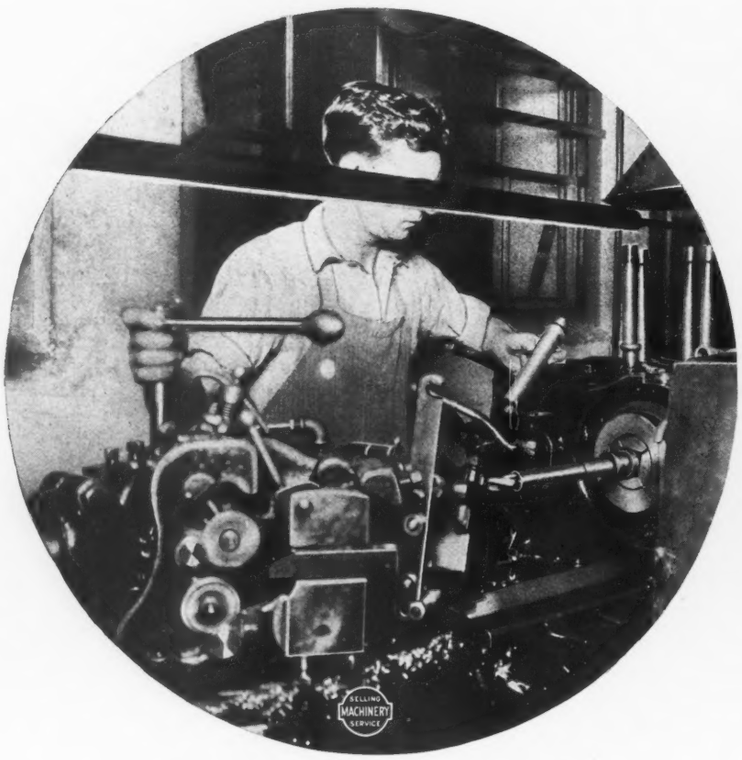


COMPANY, Cincinnati, U. S. A.

SHAPERS **RADIALS**

The J & L Flat

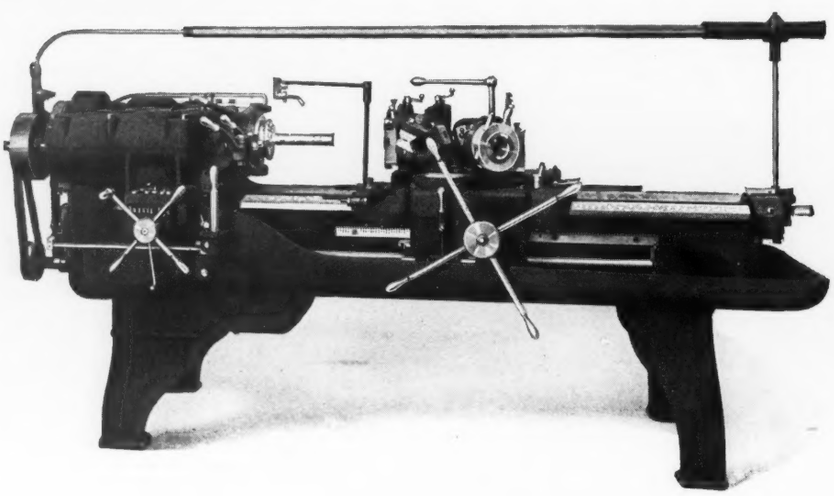
Lathe Spindles for the B. C. AMES COMPANY



The Ames Company will tell you its lathe spindles are as fine an example of accurate manufacture as can be found anywhere. And the machine selected for this work is a J & L Flat Turret Lathe.

For example — the hole through the spindle is 7½ inches, and must be straight and concentric. Production is not as interesting as the exactness of the work—both are good.

This particular machine has been installed for more than five years and used always on the finest of work. Its accuracy and durability have been demonstrated.



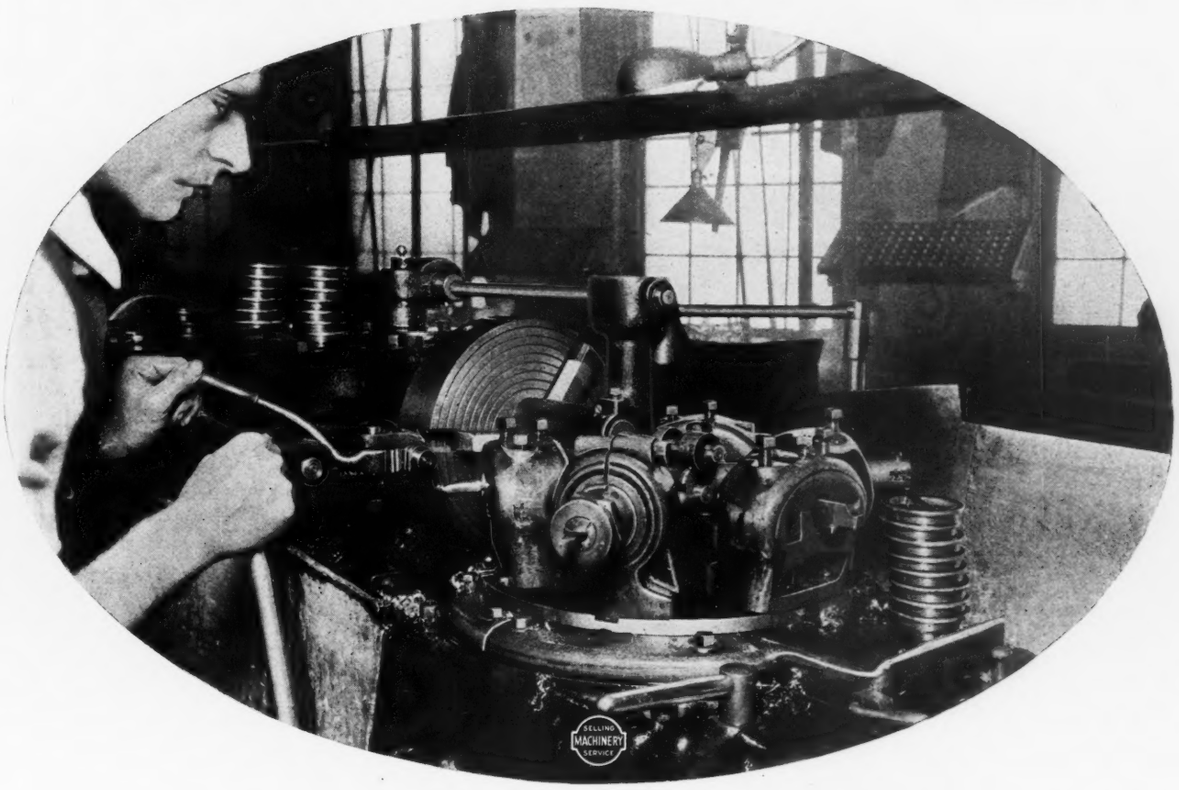
Send for more details.

Springfield, Vermont, U. S. A.

Jones & Lamson

FRANCE, SPAIN, BELGIUM: F. Auberty & Co., 91 Rue de Maubeuge, Paris.

Turret Lathe



Water Heater Taps for the Stanley Steamer

We found this job in progress at the Stanley Motor Carriage Works, Newton, Mass., where they are using a J & L thread cutting attachment to cut threads on the feed water heater tap shown. This tool cuts 16 threads per inch on a 3.109 diameter to rigid inspection requirements.

The J & L automatic thread chasing tool cuts a wide range of threads; its internal range runs from 2¼ to 11 inches diameter; external 1 inch to 11½ inches diameter, any length under 4 inches. It is a standard tool—one of many developed for use on J & L machines.

The history of the J & L Flat Turret Lathe in this plant dates back fifteen years, and their success is due to the rapid finishing of duplicate parts at minimum costs.

We'll be glad to answer inquiries.

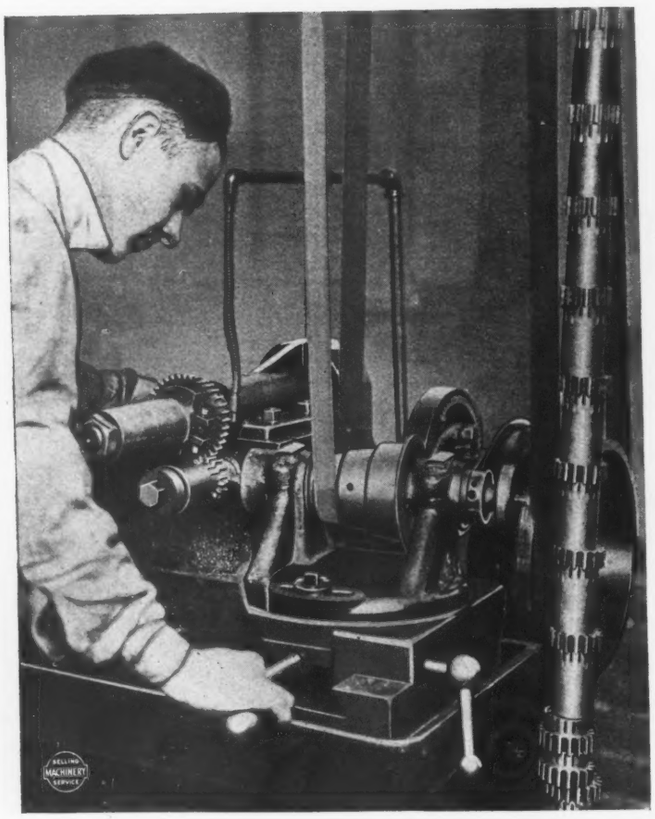
Machine Company

109 Queen Victoria St.
London, E. C.

HOLLAND: Spliethoff, Beeuwkes & Co., Rotterdam.

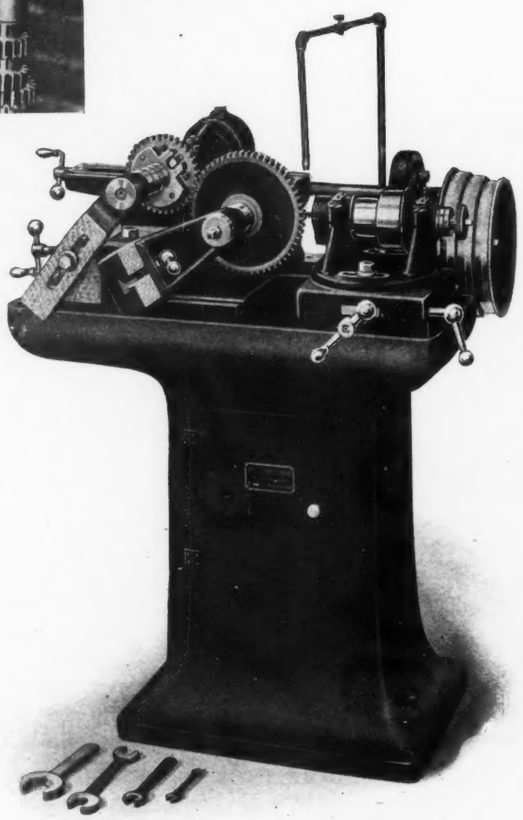
Rochester

Gear Tooth Rounding Machines



Six Years of Steady Service

Here's a photograph which explains the smooth action and long life of sliding gears used in machine tools built by the Morris Machine Tool Company, Cincinnati. It shows one of the Morris operators rounding the teeth of a 9 pitch gear, having 16 teeth of 50-point carbon steel.



Rochester Gear Tooth Rounding Machines are manufactured to round the teeth of any type gear from 1½" to 30" diameter and practically any pitch.

They will do this work at manufacturing speed, automatically and with great accuracy.

They will also remove the burrs left by the cutters on spiral bevel gears and pinions and worm gears.

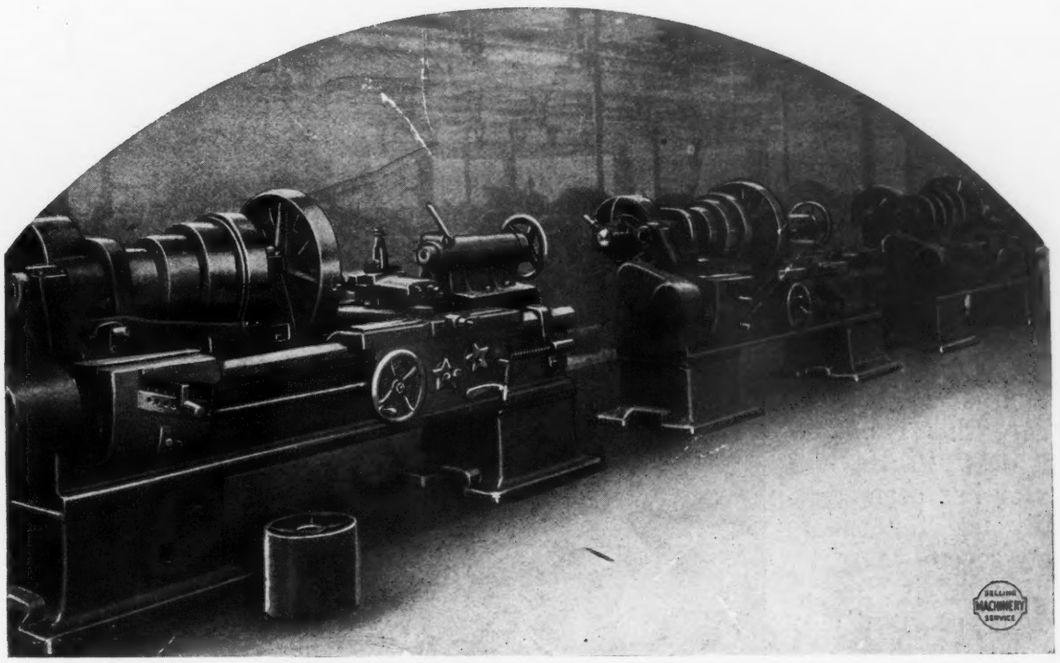
The new catalogue illustrates and describes these machines in detail. Send for your copy. It's free. And it will show you how to save money in rounding the teeth of sliding gears.

INGLE MACHINE CO.

371 St. Paul St. Rochester, N. Y.

BRIDGEFORD LATHES

Aids to the Field Pieces



THESE twenty-nine Bridgeford Lathes were recently installed in a new munitions plant, and in manufacturing high-powered projectiles will prove valuable aids to the other machines of war—"Over There."

Men who operate these tools pledge two new shells for every one their partners in France unloose. They have confidence in the ability of their machines as the gunner has in his Field Piece.

What Bridgeford Lathes have accomplished in every branch of the war's work of production proves that the confidence of their operators is not misplaced.

Make the limit of your tools the limit of your assistance.

Choose no-limit producers. Get the Bridgeford catalogue. Do it now!

BRIDGEFORD MACHINE TOOL WORKS

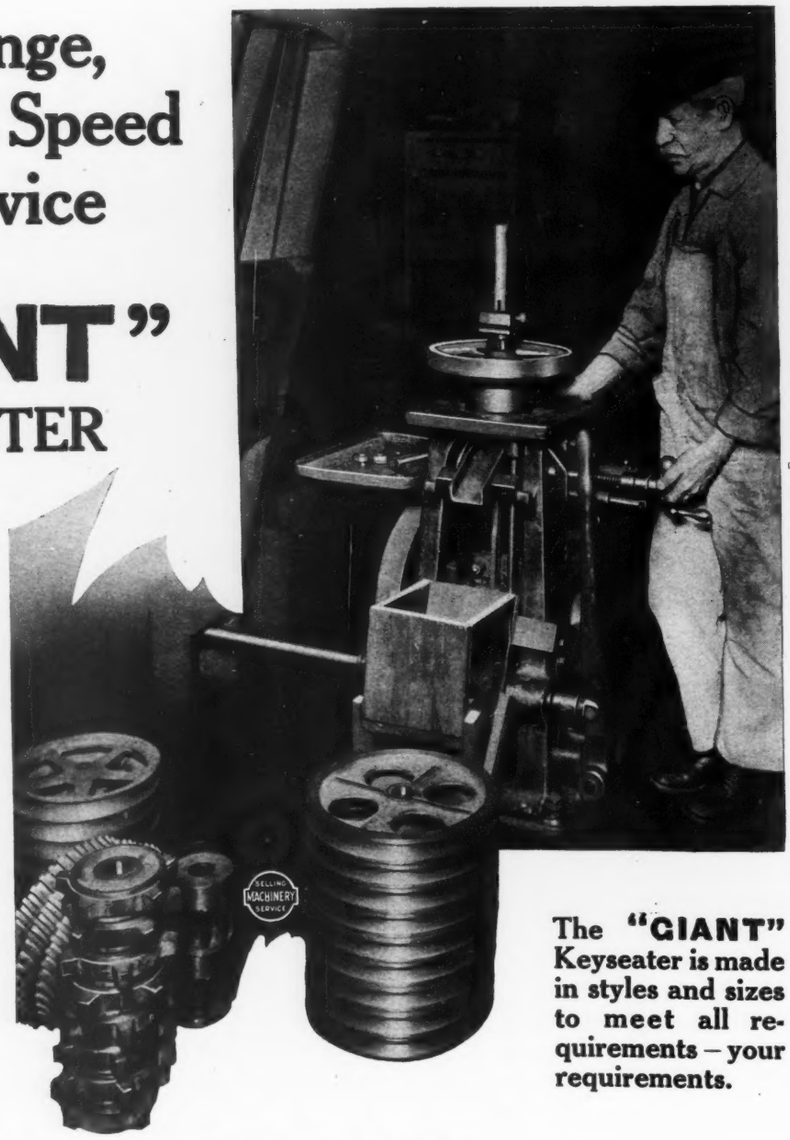
151 WINTON ROAD ROCHESTER, N. Y.

MANUFACTURERS OF HEAVY DUTY LATHES FOR MORE THAN 20 YEARS.

For Range, Accuracy, Speed and Service

use a

"GIANT" KEYSEATER



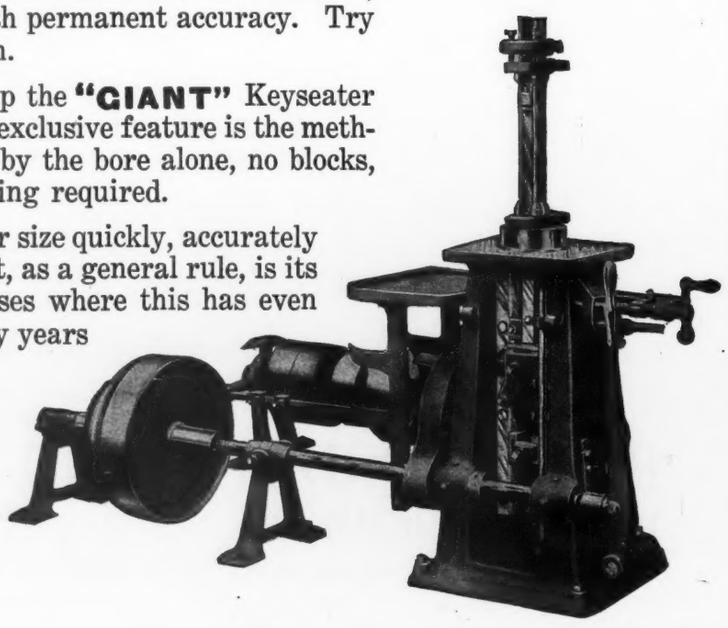
The accompanying photograph was taken in the plant of the Rochester (N. Y.) Barrel Machine Works, where this No. 2 **"GIANT"** Keyseater has been in daily use for the last seven years. Although it has been constantly employed to the extent of its capacity, it is in as good running order today as it was when first installed.

The "GIANT" Keyseater is made in styles and sizes to meet all requirements – your requirements.

All **"GIANT"** Keyseaters are noted for their first-class construction, which insures long service with permanent accuracy. Try to see an "old-timer" in action.

It takes but a minute to set up the **"GIANT"** Keyseater for a change in the work. An exclusive feature is the method by which the work is held by the bore alone, no blocks, fixtures or holding devices being required.

It cuts keyways of any shape or size quickly, accurately and economically. Its first cost, as a general rule, is its only cost, and we can cite cases where this has even been true for periods of twenty years or more.

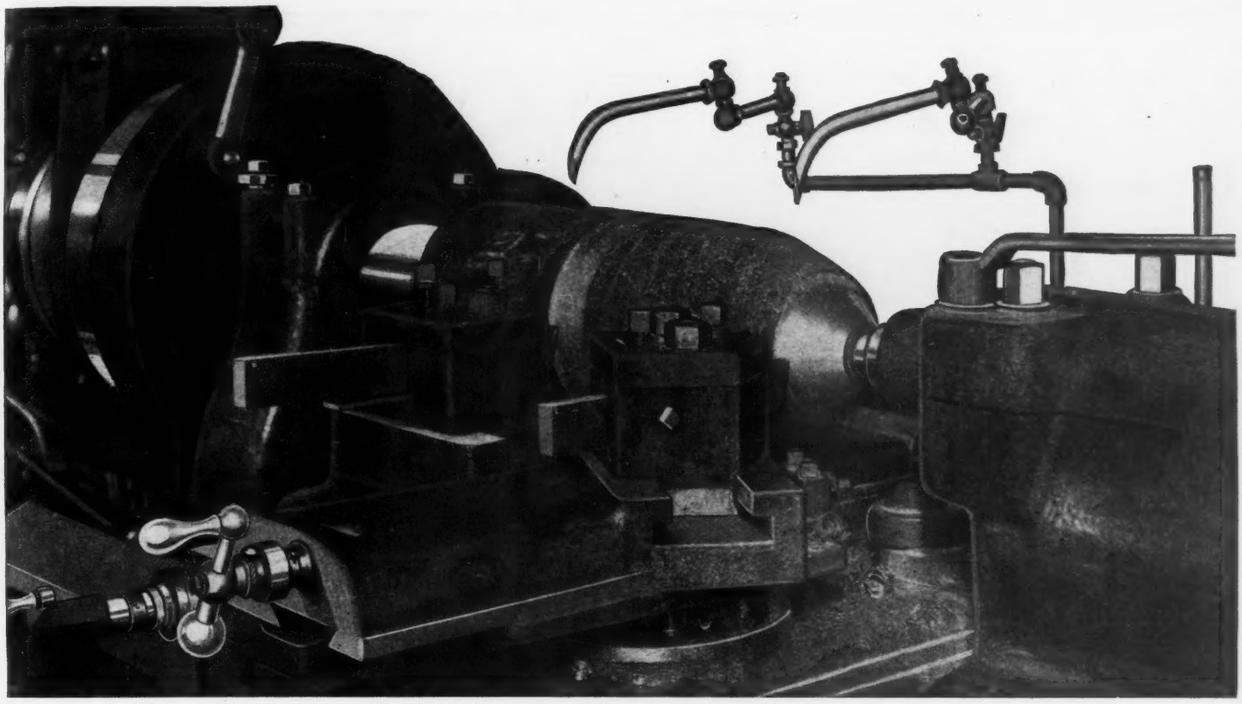


Write today for further particulars

MITTS & MERRILL

843 Water Street, SAGINAW, MICH.

FOREIGN AGENTS: Burton, Griffiths & Co., Ltd., London, England. Leon Chapuis, Paris, France.



Rough Turning 9.2 British Howitzer Shells on the LeBlond Heavy Duty Lathe

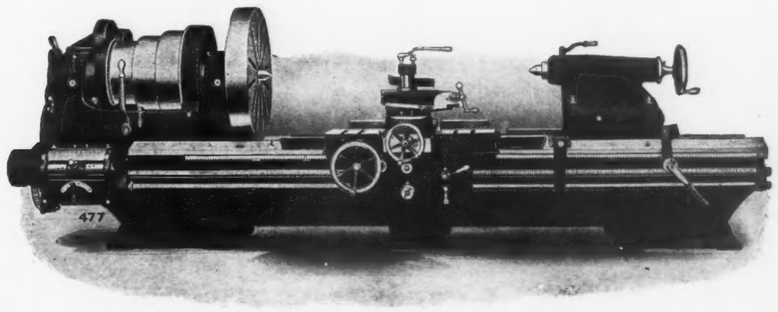
The parallel cut and nose radius are turned simultaneously. The radius is turned from the main cross slide by means of a forming attachment that picks up and overlaps the parallel cut at the end of the radius.

The straight diameter is turned from a supplementary slide.

***Time*—18 Minutes each**

***Machine*—30" LeBlond Heavy Duty Lathe**

Certain exclusive features in our design make the production possible. Positive clutch apron, patent double friction back gear, headstock, etc.



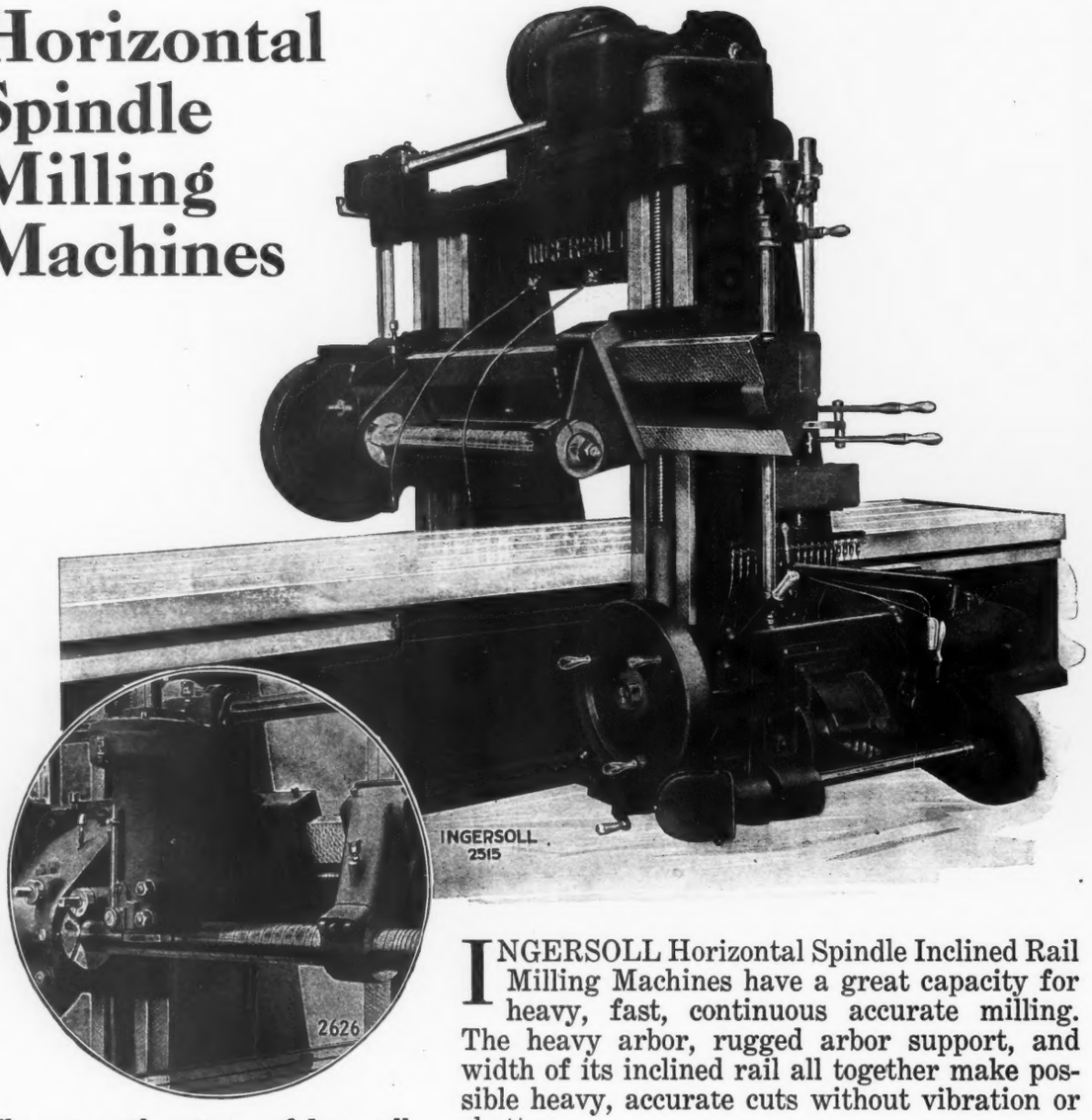
We can offer attractive deliveries

The R. K. LeBlond Machine Tool Co.

Cincinnati, Ohio, U. S. A.

INGERSOLL

Horizontal Spindle Milling Machines



There are other types of Ingersoll Milling Machines—all built in the same rugged style and with the same finish.

INGERSOLL Horizontal Spindle Inclined Rail Milling Machines have a great capacity for heavy, fast, continuous accurate milling. The heavy arbor, rugged arbor support, and width of its inclined rail all together make possible heavy, accurate cuts without vibration or chatter.

In addition, when equipped with a vertical head, this machine is of peculiar value to shops that have large keyways to cut in heavy shafts. The keyway cutter is mounted on the arbor and the routing cutter is driven by the vertical head, producing a finished keyway at one setting. The vertical head may be moved to the end of the rail out of the way when not in use.

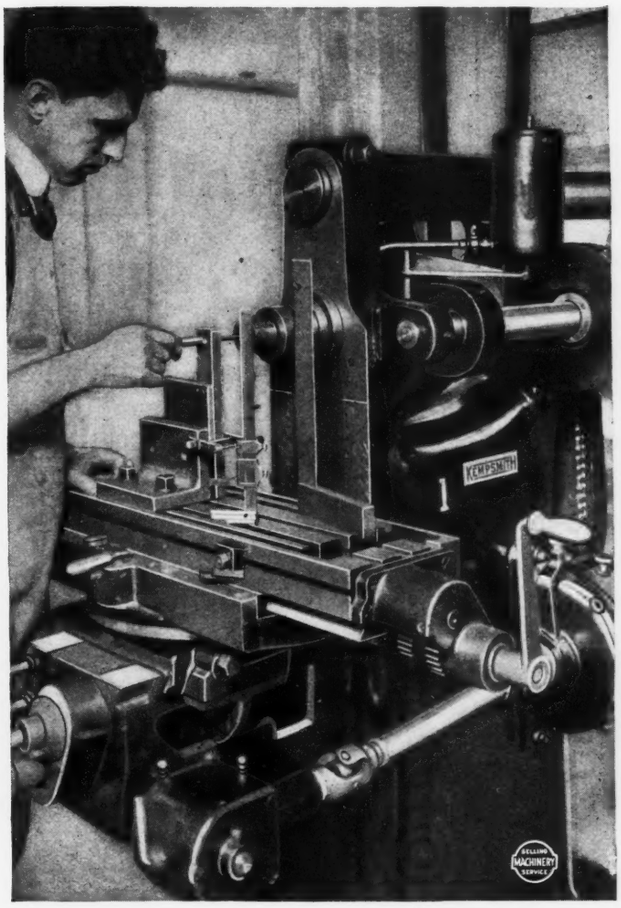
This carefully developed machine has the rugged strength and accurate precision found only in the highest class tools. All gears are cut from solid forgings and are heat-treated and carbonized. Thirty years' consistent growth has made Ingersoll Milling Machines the standard in shops where accurate tools are chosen.

The Ingersoll Milling Machine Company

MILLING MACHINES AND THEIR EQUIPMENT

Main Office and Works:
ROCKFORD ILL., U. S. A.

NEW YORK OFFICE: 50 Church St.
The Walter H. Foster Co., Mgrs.
DETROIT OFFICE: 1457 David Whitney Bldg.
H. C. Rose, Mgr.



The KEMPSMITH Universal Miller *is a* Profitable Machine

In The Contract Shop

Accuracy to 0.0001″ is not simply a claim in the Atcheson & Barok Die Tool Company, it is a guarantee — to which the Kempsmith Miller is first aid.

Jig boring—shown in the picture—is one of the 0.0001″ jobs on which the "Kempsmith" distinguishes itself. There's also a large amount of government work executed in this plant—for which requirements are always exacting—and here again the "Kempsmith" takes a leading part. The same well-balanced construction and careful workmanship which have made the Kempsmith Miller's reputation for strength and rigidity, permit a degree of accuracy that is particularly appreciated in the toolroom. The universal features, convenient control and ready adaptability make it a profitable miller for the contract shop.

Kempsmith production data on work similar to yours at your disposal. Write.

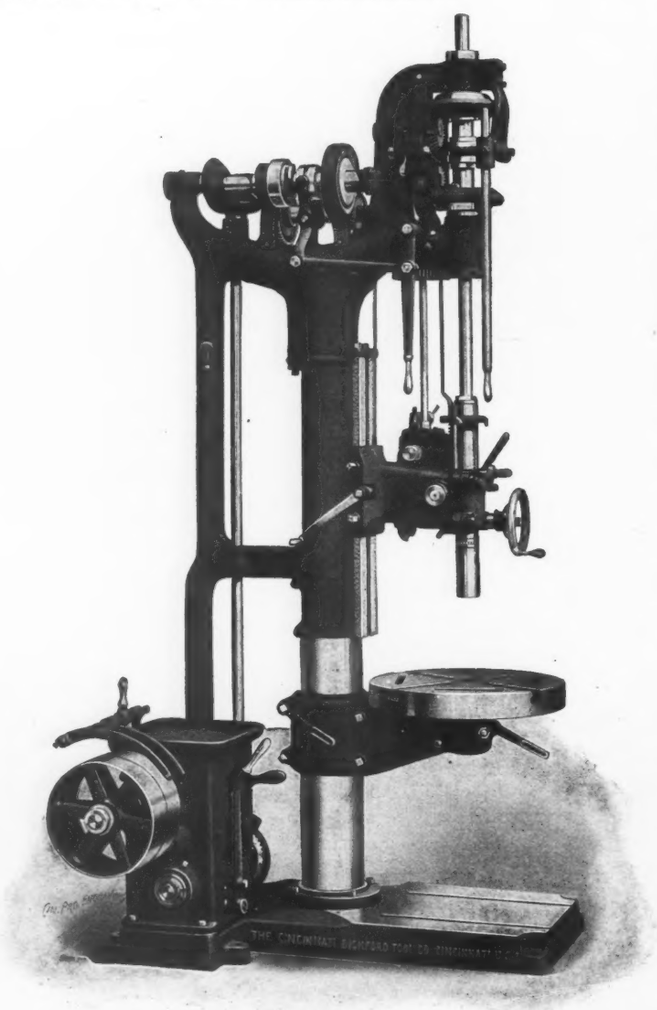
KEMPSMITH MILWAUKEE, U.S.A.

THE CINCINNATI

UPRIGHT DRILLING MACHINE

A Tool That "Grew Up"

The initial product of the Cincinnati Bickford organization made its appearance 44 years ago, and though crude in some respects, many of its type are still doing service in various lines of work. This machine had but three feeds and to change from one to another required the troublesome shifting of a belt on cone pulleys. Some builders have never departed from this construction.



The Cincinnati has "grown up." And now—it has "all geared" drive, conserving power and minimizing wear on bearings; sixteen speeds —38 to 534 r.p.m. in the 24″, 28″ and 32″ sizes and 33 to 428 r.p.m. in the 36″ and 42″ sizes; six positive, quickly obtainable feeds from 6 to 39 thousandths in the 24″, 28″ and 32″ sizes and from 7 to 49 thousandths in the 36″ and 42″ sizes; friction back gears and patent geared tapping attachment which engage without shock while machine is in operation.

And we'd like to go into details about that tapping attachment. It's a drilling machine feature which you ought to know about. Write us and we'll gladly send the full story in Circular U-4.

THE CINCINNATI BICKFORD TOOL

U546.

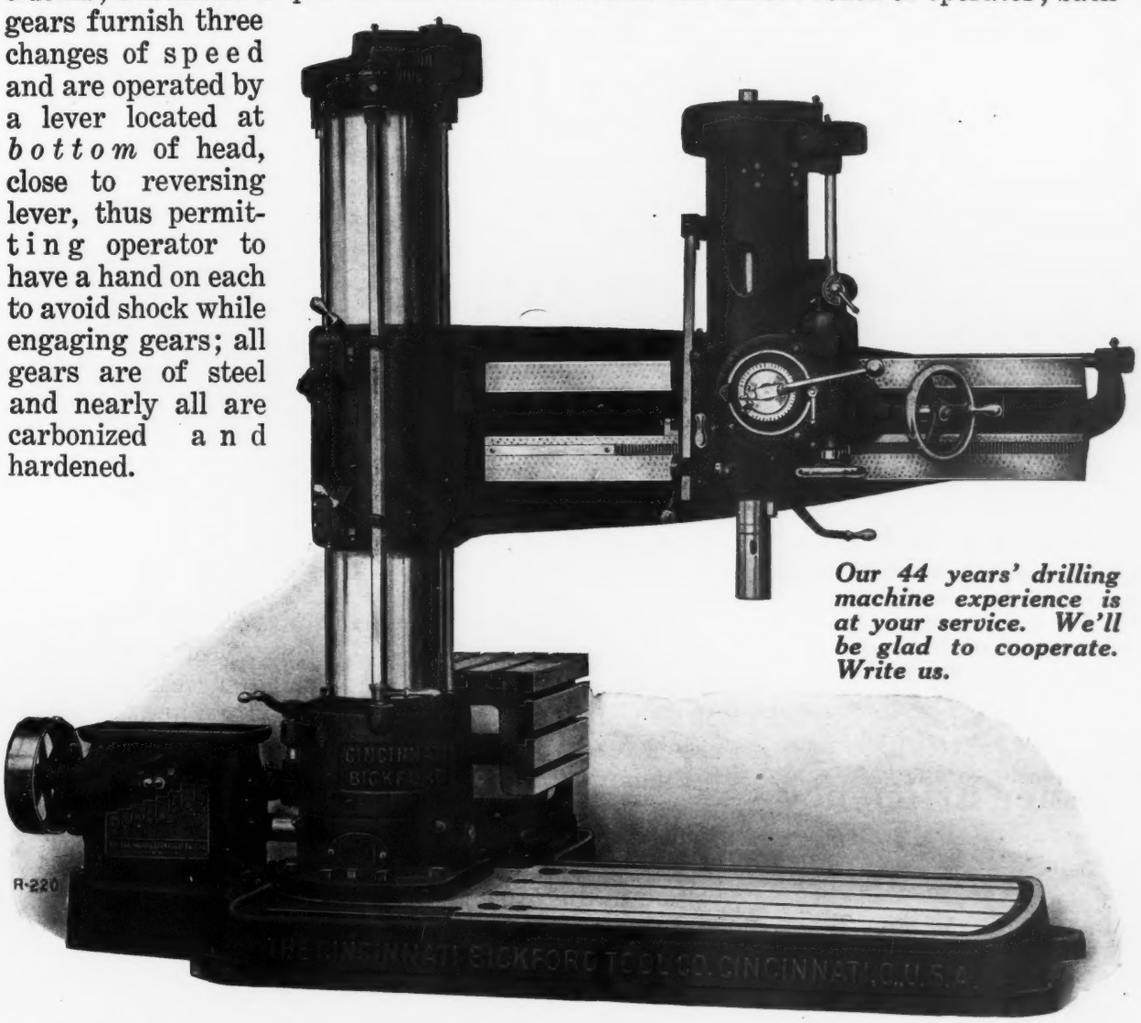
THE CINCINNATI BICKFORD

RADIAL DRILLING MACHINE

As Adaptable As It Is Able

The Cincinnati Bickford was the *first* modern type radial, and the fact that it remains foremost today is significant of what years of specialization have accomplished. Twenty-four claims were allowed on the original tool and scores of others have been granted since—proof of the many improvements in the present design. It is unequalled in range and adaptability.

The arm, entirely enclosed on all sides, affords an unusual degree of stiffness, and is provided with a narrow guideway; "fool-proof" elevating mechanism prevents accidents; automatic trip is in full view and within convenient reach of operator; back gears furnish three changes of speed and are operated by a lever located at *bottom* of head, close to reversing lever, thus permitting operator to have a hand on each to avoid shock while engaging gears; all gears are of steel and nearly all are carbonized and hardened.



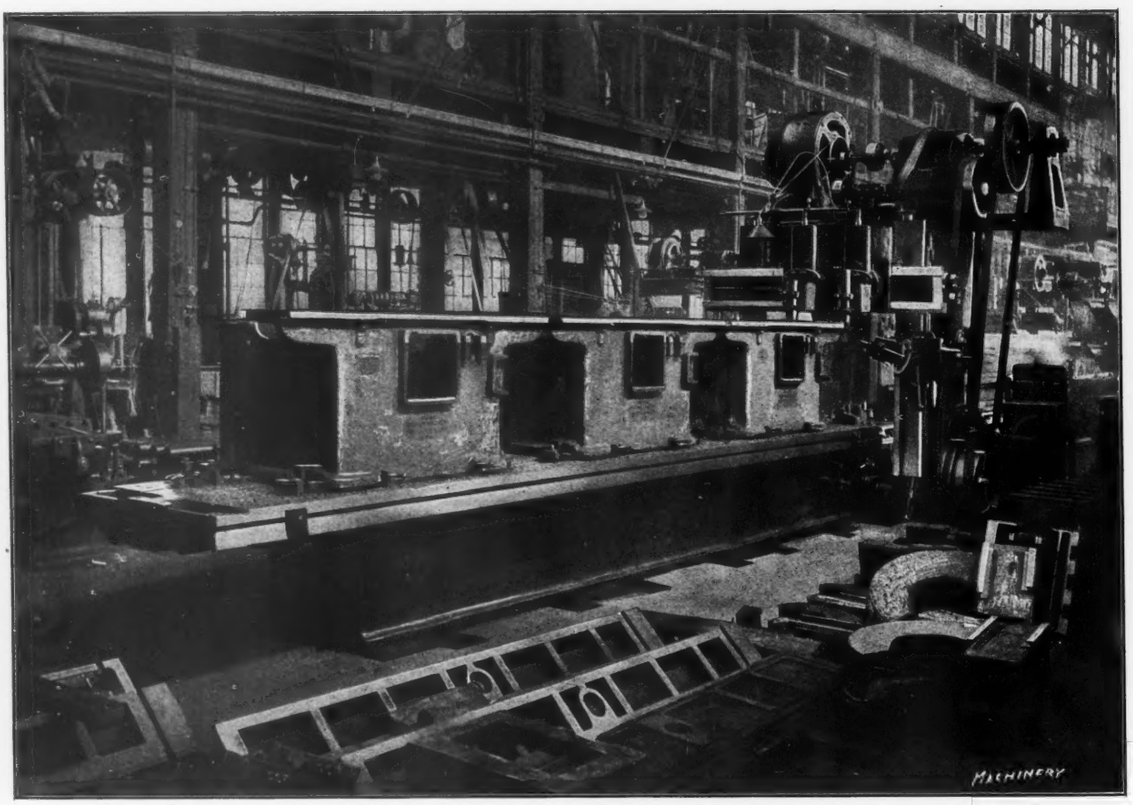
Our 44 years' drilling machine experience is at your service. We'll be glad to cooperate. Write us.

COMPANY, Oakley, Cincinnati, U. S. A.

R546

CINCINNATI PLANERS

Eleven of Them in This Plant



Efficiency Planers

Planer Efficiency

Send for the circular.

There are eleven Cincinnati Planers in this big "down East" grinder manufactory, each daily accomplishing work that is a credit to the installation.

The operation shown is machining the ways of three grinders at the same setting. Extreme rigidity and accurate alignment are vital to the successful completion of this job. The fact that Cincinnati Planers have seen many years' service in this plant is testimony for their efficiency.

Micrometer adjustments, graduated in thousandths on all vertical and horizontal screws, provide means for obtaining any depth of cut rapidly and accurately. Great variety of speeds is another important feature.

CINCINNATI PLANER COMPANY

CINCINNATI, OHIO, U. S. A.



Cincinnati-Acme

Combination Flat Turret Lathe

Cuts Out the "Preliminaries"

The operation shown in the photograph is machining an 18 inch gear blank and the particular advantage in using the Cincinnati-Acme Combination Flat Turret Lathe on this class of work is that much of the customary setting up can be eliminated.

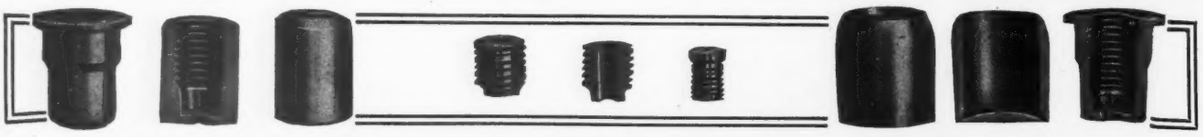
All dimensions on these gear blanks must be held to plus or minus 0.001". That this is being satisfactorily accomplished is evident from the fact that the Union Gear and Machine Company of Boston, where the photograph was taken, has recently supplemented its Cincinnati-Acme equipment by still another machine.

"A watched Cincinnati-Acme needs no further advertisement."

When you want a time-saving, vibrationless lathe you should have the details of the Cincinnati-Acme handy.

THE ACME MACHINE TOOL CO.

CINCINNATI, OHIO, U. S. A.

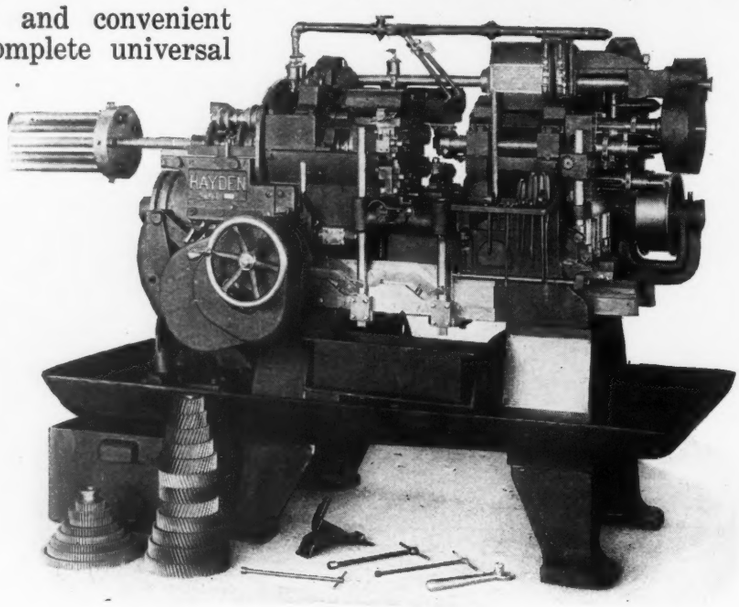


SIMPLICITY in design and convenient operation make this complete universal Automatic Screw Machine profitable for jobbing as well as manufacturing purposes. It will show a profit on even comparatively short runs.

THE

"HAYDEN"

has nine cutting tools—any one of which can be brought into position by a hand lever—a gage for the quick setting of circular tools and other distinctive advantages—47 in all—which make its records notable even in this day of unprecedented production.



We claim it to be the best all round machine of its class and are ready to prove it. Catalog for details.

CINCINNATI AUTOMATIC MACHINE CO., Oakley, Cincinnati, Ohio, U. S. A.

Do Those Unusual Jobs on a

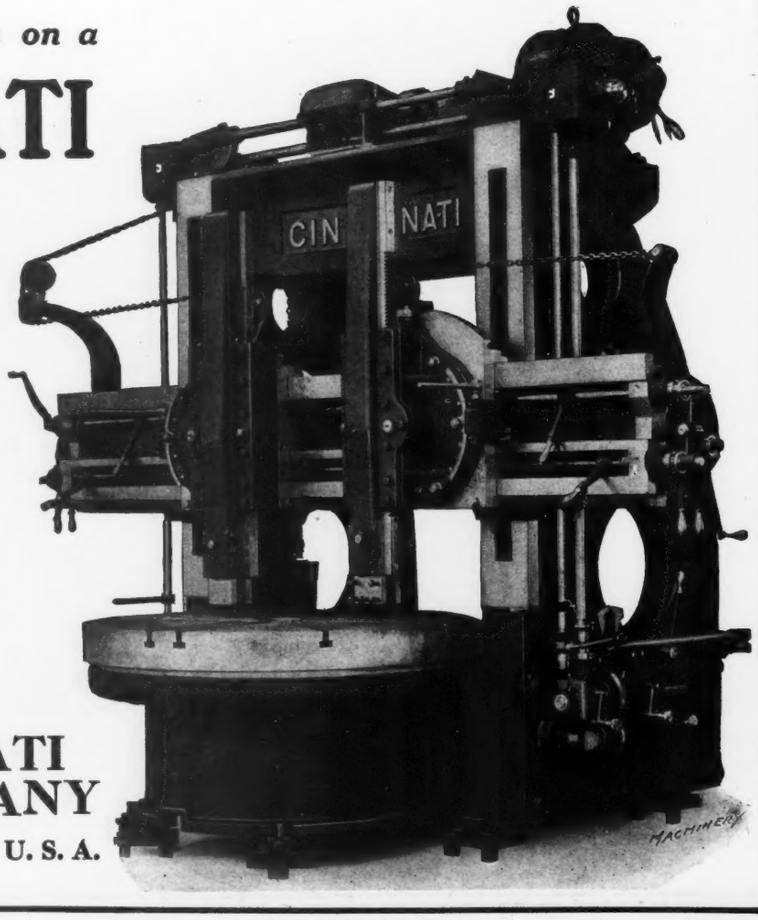
CINCINNATI

BORING MILL

The Cincinnati Boring Mill is more than its name implies—it is a most versatile general manufacturing tool—big, powerful, yet convenient and easy to operate and extremely accurate in its special field, machining work of large diameters.

It is particularly desirable in big, busy shops, where unusual jobs are certain to arise.

Sizes up to 16 feet.
Complete description upon application.



THE CINCINNATI PLANER COMPANY

CINCINNATI OHIO, U. S. A.

AUGUST *and the Coupon*

A list of the men who would rather run a lathe than an automobile during the month of August could be written on the back of a postage stamp with a paint brush.

The "boss" who knows and understands this truth has a much better chance of weathering labor conditions than the one who doesn't.

Though you can't furnish the automobiles and spare time, you can provide the lathe that's least likely to aggravate the situation—pick the lathe that will do the heavy work with a minimum strain on the operator.

It's your own fault if you don't know that this is a G-K specialty. For the last six months we've emphasized our willingness to send you the news on what's what in modern lathe building. However, we won't chide—get the coupon off now. We'll try to make deliveries before the "dog days" get monotonous.

The Greaves-Klusman Tool Co.,
Cincinnati, Ohio, U. S. A.

Your advertising has interested me. Send the G-K story.

Name.....

Address.....

MACHINERY



THE GREAVES-KLUSMAN TOOL CO.

CINCINNATI, OHIO, U. S. A.

The Fairbanks Company, New York City, Philadelphia, Pa., Boston, Mass., Washington, D. C.; Federal Machinery Sales Company, Chicago, Ill.; J. R. Stone Tool and Supply Co., Detroit, Mich.; Marshall & Huschart Machinery Company, St. Louis, Mo.; William K. Stamets, Pittsburgh, Pa.; Hallidie Machinery Co., Seattle, Wash.; Hallidie Company, Spokane, Wash.; Neill, Laville Supply Co., Louisville, Ky.

GREAVES-KLUSMAN

HIGH QUALITY—LATHES.

FOREMOST



Model No. 34

The Highest Development in Modern Bore Grinders

The Van Norman Model No. 34 Bore Grinder is the highest development in machines for the accurate production of short straight or taper holes. It embodies many original features to meet the rigid requirements of ball and roller bearing race manufacturing and other instances where precision grinding of similar nature is performed.

It has the same refinement of cross feed and cut-out mechanism as is employed in the well-known Van Norman Oscillating Grinder.



This new Van Norman Grinder is rapid, accurate, compact and convenient. To illustrate the last mentioned qualification: a single movement against one hand lever disconnects latch and withdraws the wheel slide; similar action with the other hand carries the work head outward on cross slide ways at right angle to the wheel spindle, giving ample clearance for testing and loading.

We want to make you thoroughly acquainted with this machine. If you can't conveniently see it for yourself in actual operation, write us.

VAN NORMAN MACHINE TOOL COMPANY

Waltham Avenue, SPRINGFIELD, MASS.

VAN NORMAN

There's No Danger

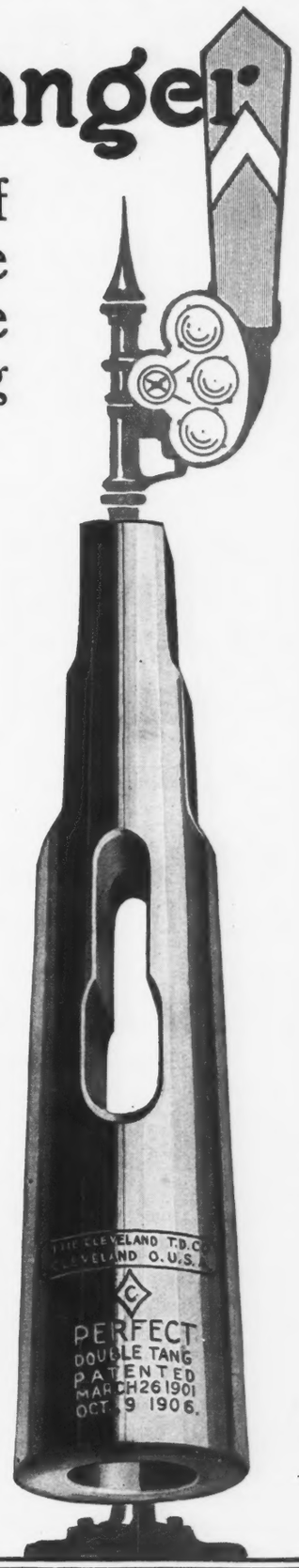
When a tang twists off don't endanger the true taper and the axis of the tool by delicate grinding jobs. Insist on

Perfect Double Tang SOCKET

"Perfect Double-Tang" Sockets are easily applied—just grind a new tang below the old and broken one; almost any boy can do it—and without the least danger to the future performance of the tool.

In fact "Perfect Double-Tang" actually makes the tool 25-60% stronger than before, and is equally valuable in *preserving* new tools from tang troubles, or in *reclaiming* broken tanged tools.

Send for "Rob the Scrap Heap"



THE CLEVELAND TWIST DRILL COMPANY

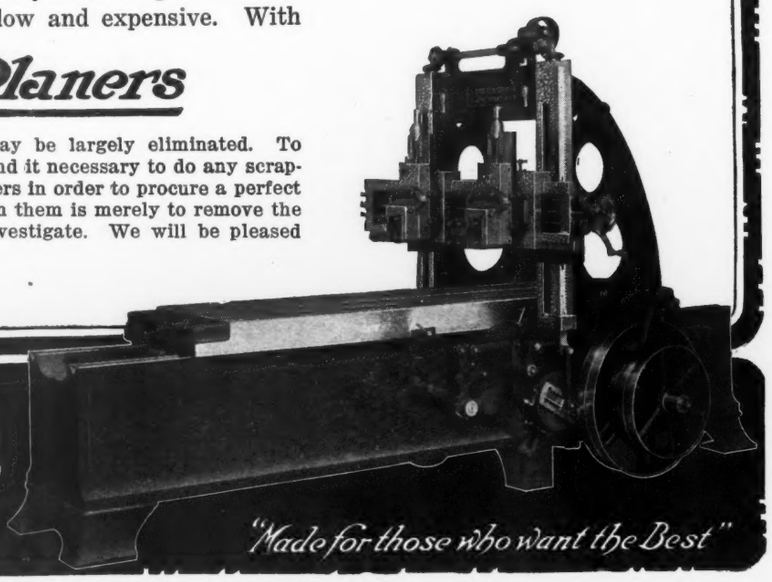
NEW YORK CLEVELAND CHICAGO

Gray Planers

If a job is not turned true, you can improve it by grinding. If it is not bored true you can improve it by reaming. But—if it is not planed true you can improve it only by hand scraping, which is slow and expensive. With

Gray Planers

and some "know how" scraping may be largely eliminated. To prove this, will say that we do not find it necessary to do any scraping on the beds or tables of our planers in order to procure a perfect bearing. The only scraping we do on them is merely to remove the "loose iron." It will pay you to investigate. We will be pleased to have you call.



THE G. A. GRAY CO.
CINCINNATI, OHIO.

"Made for those who want the Best"

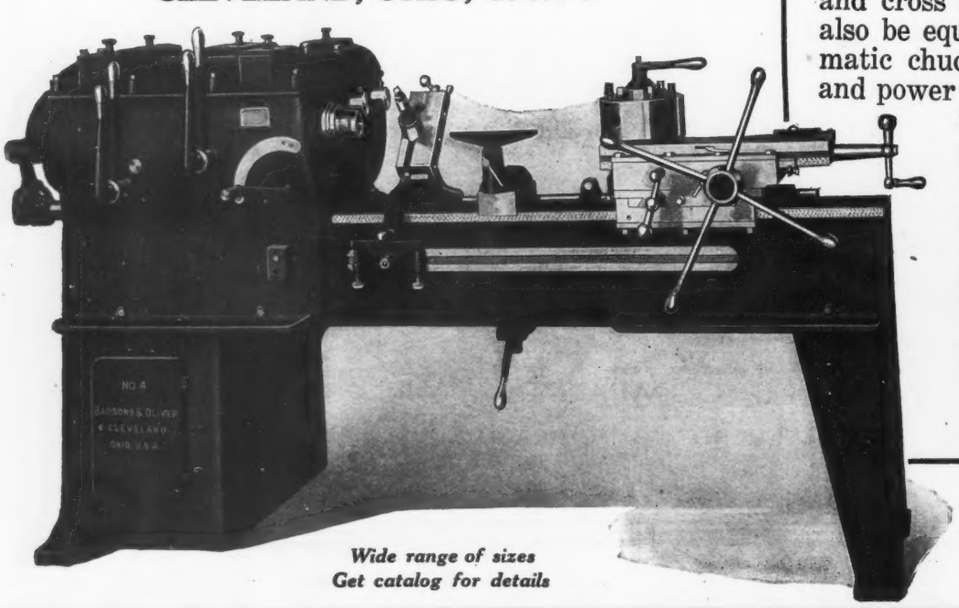
"FOX" LATHES

Motor Driven Lathes of Quality

Built by

BARDONS & OLIVER

CLEVELAND, OHIO, U. S. A.



Wide range of sizes
Get catalog for details

THIS "Fox" Lathe is noted for its exceptionally compact construction. Selective speed all-geared head eliminates overhead shafting. It has eight spindle speeds, chasing and taper attachments, universal turret slide and saddle with longitudinal and cross motion. It may also be equipped with automatic chuck and wire feed and power longitudinal feed to turret slide. Reverse is instantaneously obtainable by means of friction clutches, spindle only being reversed, motor and fast running shafts always turning in same direction.

The "Fox" Lathe may be handled efficiently in any available part of the shop.

MAN-POWER



MAY BE CONSERVED

BY USING TOOLS THAT ENABLE THE INDIVIDUAL WORKER TO PRODUCE MORE. INCIDENTALLY SUCH TOOLS ALSO SAVE TIME AND POWER AS WELL

"MORSE" DRILLS ARE SUCH TOOLS

THE MEN WHO USE THEM KNOW

MORSE TWIST DRILL & MACHINE CO.

NEW BEDFORD, MASS.

NICHOLSON

A Shearing Cut Without Channels or Furrows

That is the kind Nicholson Files give. The teeth of Nicholson Files are so formed as to have a keen cutting edge combined with strength to withstand pressure, and ability to free themselves from chips.

NICHOLSON U.S.A. (TRADE MARK)

NICHOLSON U.S.A. (TRADE MARK)

While we carry over 6000 varieties in stock, there are two grand divisions of Nicholson Files, namely, the Increment Cut Files for all ordinary work, and the X-F Swiss Pattern Files for jewelers, watch and tool makers.

Nicholson Files are not only the standard of America, they have a world-wide reputation. Some of New England's rugged honesty of character went into Nicholson Files 52 years ago—and has stayed there.

Send for a copy of "File Filosophy"—
it will help and interest you.

BY INVITATION MEMBER OF

NEW YORK, U.S.A.

NICHOLSON FILE CO.
PROVIDENCE RHODE ISLAND

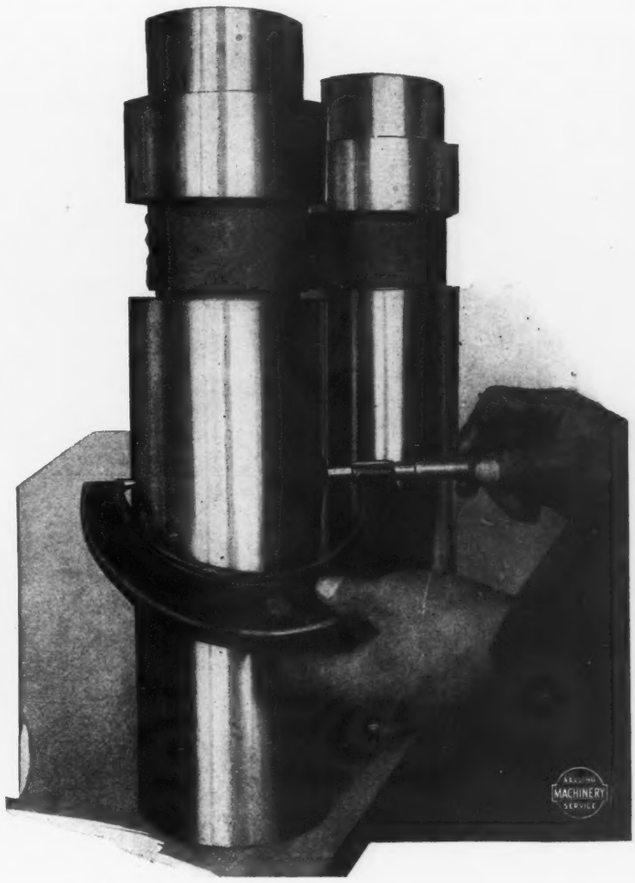


1893-1918

HARDLY more than a generation ago an order for shafting would be accompanied by a horseshoe closed together for calipering—the only "specification" other than the approximate length. It's a long way from this primitive gage to the

SLOCOMB MICROMETER

—from yesterday's slow and expensive rule of thumb methods of "fitting" to the speedy, economical, interchangeable manufacturing of today.



It is 25 years since the first Slocomb Micrometer made it's appearance. Today the line includes micrometers for testing any and all kinds of work from 0 to 30 inches—accurate to any required degree and used wherever requirements are exacting and standards high.

The Slocomb Micrometer has a tool steel screw with extra long bearing on nut and other distinctive features that make it "the longest lived micrometer that can be bought."

SLOCOMB MICROMETERS ARE USED ALL OVER THE WORLD

Reg. U. S. Pat. Office

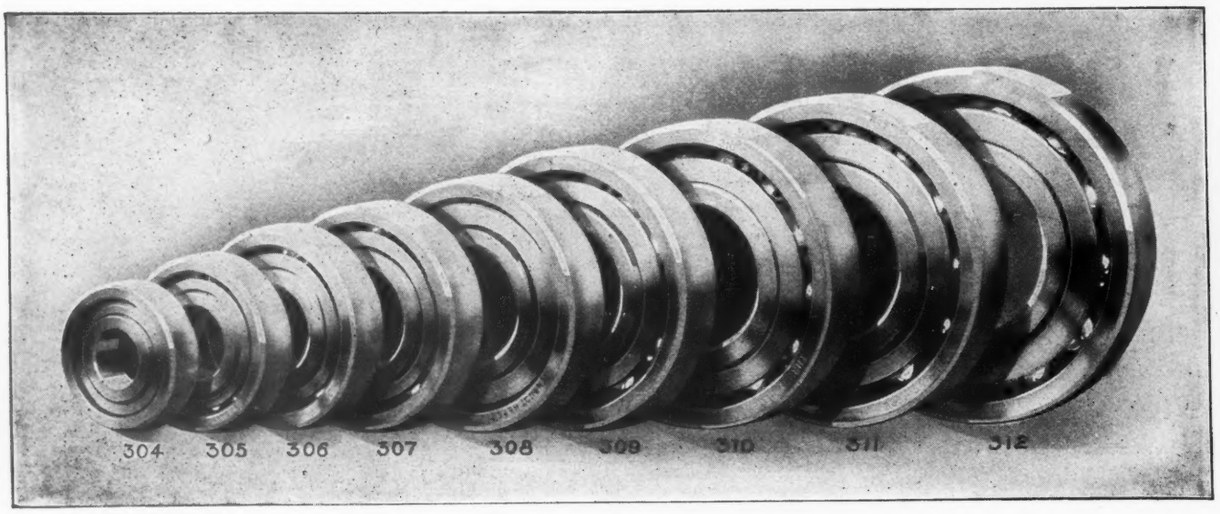


Details in Catalog 15.

J. T. Slocomb Co.

PROVIDENCE, R. I. U. S. A.

FOREIGN AGENTS: England: Chas. Churchill & Co., Ltd., London, Birmingham, Manchester, Newcastle-on-Tyne and Glasgow. Japan: Alfred Herbert, Ltd., Yokohama. Italy: Chas. Civita, Milan. Australia: Edwin Wood, Pty., Ltd., Melbourne and Sydney.



The Secret of the 57 Sizes of "Standard List" Ball Bearings

"Standard List" Bearings made to fit 19 shaft sizes

HEAVY-duty ball bearings were first manufactured in Continental Europe and were imported to this country in considerable quantities before any of the American manufacturers had become well established. Consequently American machinery manufacturers accepted the standard metric sizes in which the imported bearings were made, and these sizes were finally adopted as standard by the various American Ball Bearing manufacturers, and by the Society of Automotive Engineers.

The fifty-seven sizes on the "Standard List" are made to fit nineteen different shaft sizes, which vary by five-millimeter intervals from twenty millimeters (.7854 in.) to 110 millimeters (4.3307 in.). These nineteen shaft sizes will cover all ordinary requirements, but for heavy machinery "extra large sizes" for shafts up to 210 mm. (8.2678 in.) and for load capacities up to 44,000 pounds, are made to order.

Each bearing size is identified by a number. The last two figures of this number indicate the size of the shaft which the bearing will fit, and in all the standard sizes, the last two figures of the bearing number, when multiplied by five, will give the bore of the bearing in millimeters. For example, the No. 304 bearing has a bore of twenty millimeters, the 310, fifty millimeters and the 319, ninety-five millimeters.

For each of the nineteen shaft sizes, bearings are furnished in three weights or series. The difference between the different series will be explained in our next advertisement in this publication.

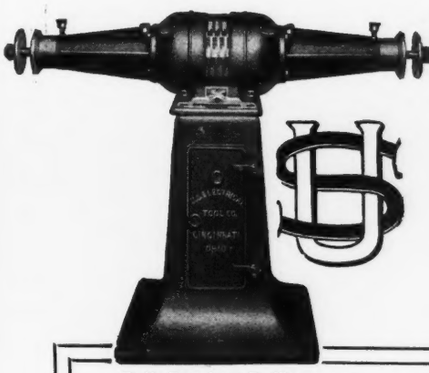
Gurney Ball Bearing Company

Conrad Patent Licensee

Jamestown, N. Y.

274

GURNEY

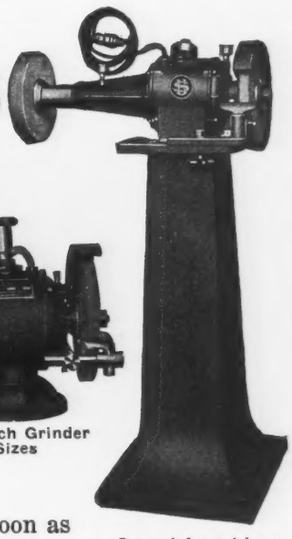


Ball Bearing Buffing Machine

Some Advantages of U. S. Electrically Driven Tools



Type K Bench Grinder Four Sizes



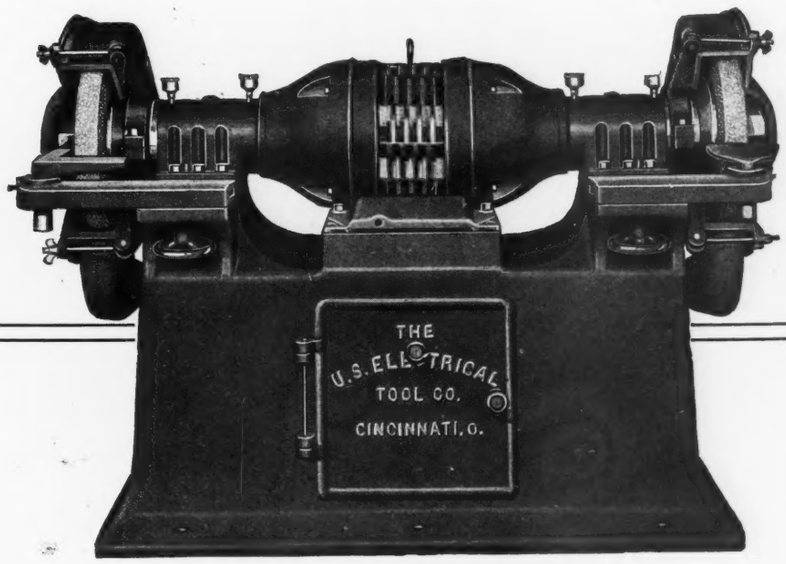
Combination Grinding and Buffing Machine. Two Sizes—Canvas or Wire Belts

U. S. Electrically Driven Tools are ready for immediate use as soon as they are uncrated. There is no delay for assembling, correcting or aligning and no expense for transmission equipment. They can be located and relocated at will; they utilize power only when actually at work; may be operated continuously without getting hot.

We have had over 30 years' experience in building electrical tools and design our motors specially to fit the machines.

Besides our well known Portable Drills and Grinders, U. S. Electrically Driven Tools include a comprehensive line of grinding, buffing and combination machines to which the heavy duty model, shown below, is the latest addition.

Accurate, durable and fully self-contained, details are fully set forth in our catalog, but to fully appreciate the wide range adaptability and efficiency of these machines, you must try them in your own shop.



HEAVY DUTY GRINDER

THE UNITED STATES ELECTRICAL TOOL CO.

6th Ave. and Mt. Hope St., CINCINNATI, OHIO

STOCK CARRIED IN BRANCHES

New York Office
50 Church Street
Chicago Office
549 West Washington Boulevard

St. Louis Office
610 Commercial Building
Boston Office
12 Pearl Street

Detroit Office
18 Columbia St., West
Philadelphia Office
The Bourse



Strom BEARINGS

FORMERLY U.S. BALL BEARINGS

Where speed means life—and death darts above the clouds—there Strom Bearings keep ever at the flyer's command a steady flow of frictionless power. With their big balls and deep grooves without notches, they are chosen by engineers wherever most dependable and economical bearing service is required.



U. S. Ball Bearing Mfg. Co.

Conrad Patent Licensee

Palmer Street and Kolmar Avenue, Chicago, Illinois

UNION CUTTERS

With Wide-Spaced Teeth For Efficiency

SLOTTING DESK FAN BASES



THE accompanying photograph shows a pair of Union Cutters, 7″ diameter and 1 1/16″ wide, slotting desk fan bases to a depth of 1 3/4″. Castings are mounted on the table four at a time, cutting is practically continuous, production is 600 slots per day (10 hours).

The wide spaced teeth of Union Cutters insure free action, ample chip room, minimum power consumption and long service between grinds.

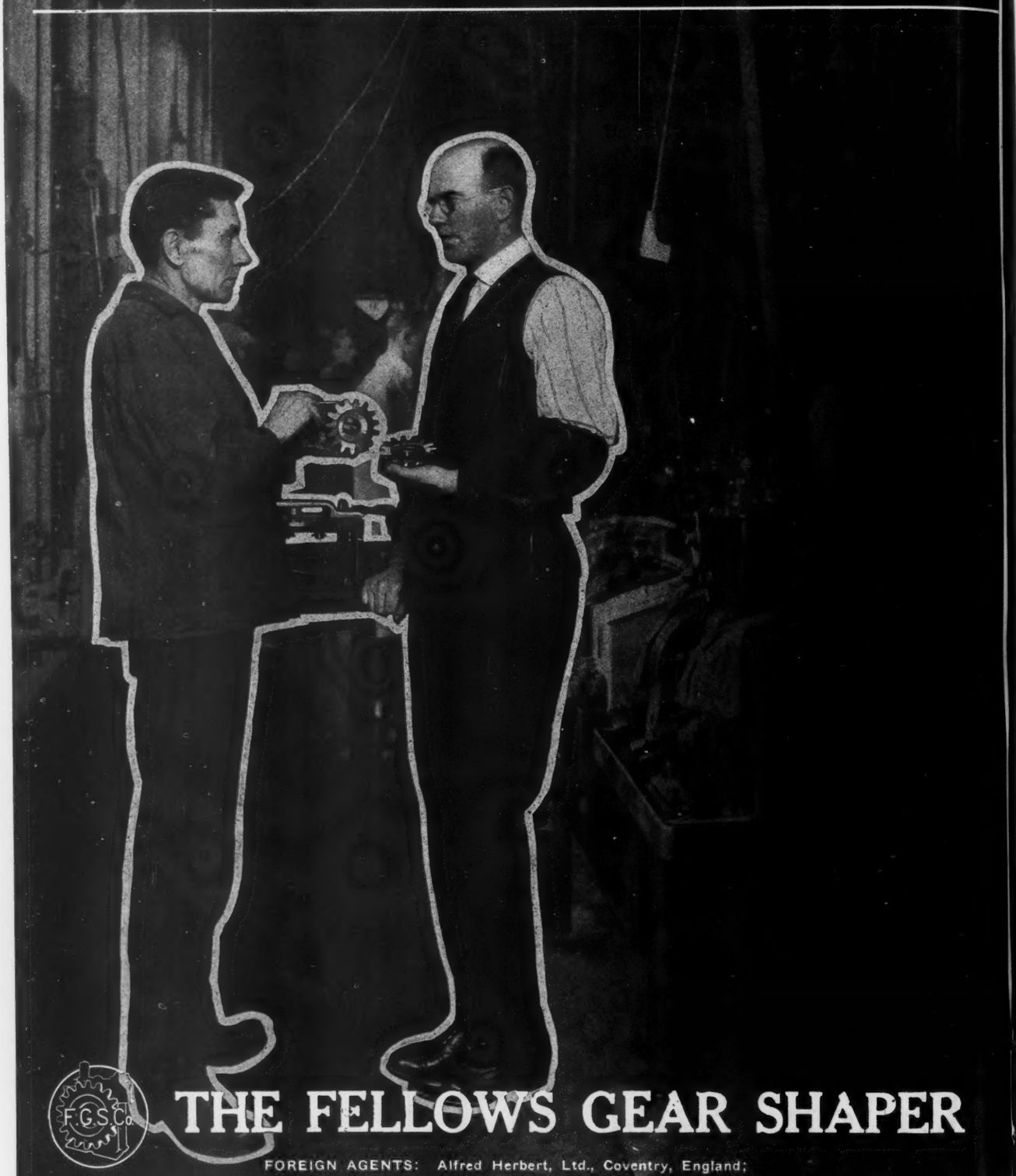
Try them and profit by these advantages

Send for Book of Information, Edition "G" for details of the complete line of cutting tools

Union Twist Drill Company

ATHOL MASS.

THE FINAL PROOF



THE FELLOWS GEAR SHAPER

FOREIGN AGENTS: Alfred Herbert, Ltd., Coventry, England;

OF ACCURACY

Don't fool yourself. You can't cut an accurate and efficient helical gear with an inaccurate cutter. Be the gear cutting machine ever so accurate, the cutter is the final arbitrator.

And speaking about cutter control, this must be positive and rigid, not flexible. If not positive, the best cutter that was ever made is no better than the worst.

In July Machinery we illustrated and explained the helical control mechanism which is used on the Fellows Helical Gear Shaper, and which guides the cutter in a positive and rigid manner.

The designer on the opposite page is now being shown the Helical Gear Shaper Cutter—*the secret of perfect helical gears.* This cutter has the involute curves of the teeth generated by a grinding process after hardening in the same manner as the Gear Shaper Cutter used for cutting spur gears.

This Point Is Important

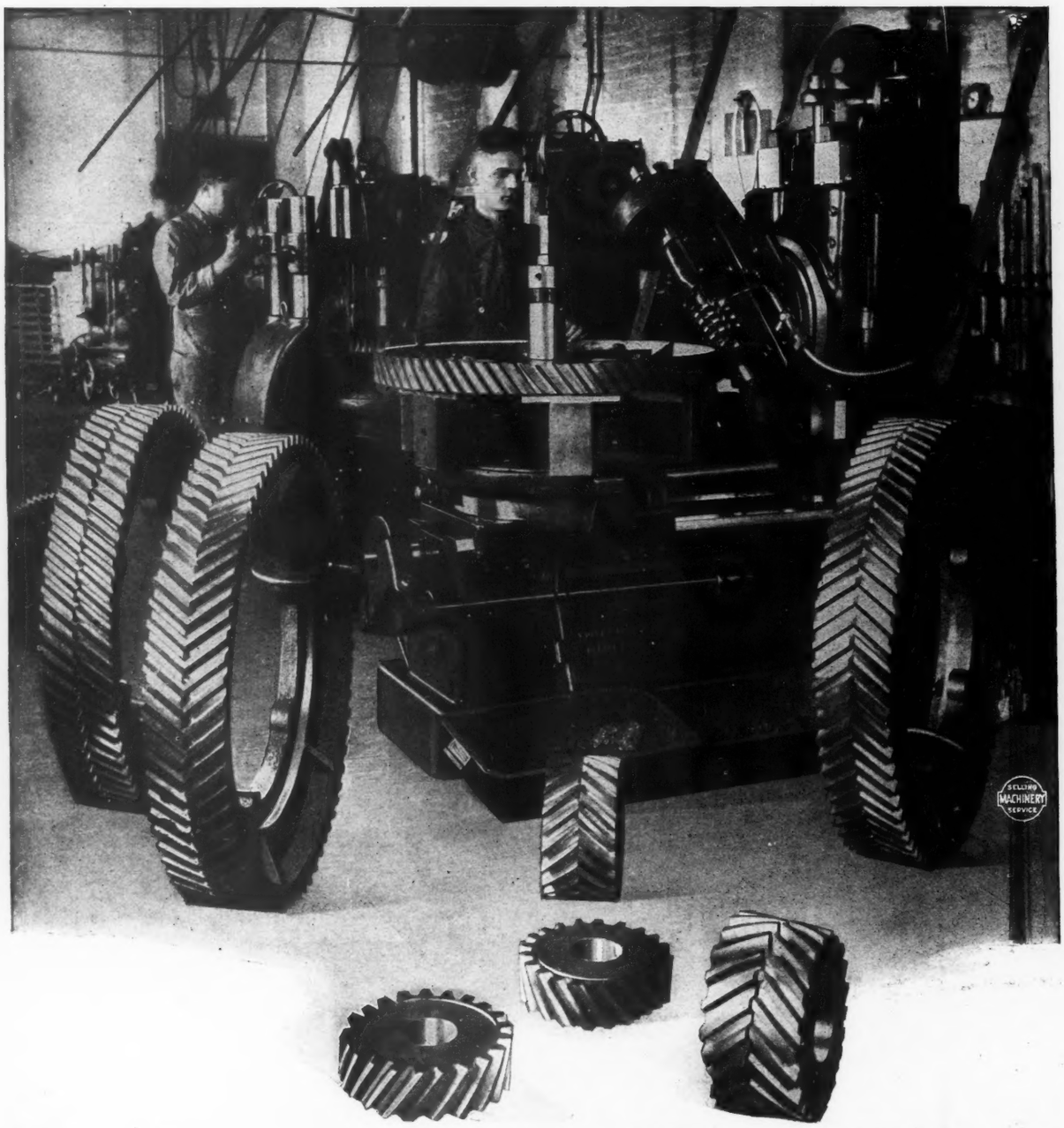
With the Helical Gear Shaper there are no "gears" to calculate. The feed of the cutter and the helix angle produced have no connection whatsoever. There is no jumping from pillar to post only to find in the end that you cannot get the helix angle you want. It is just as easy to cut a helical gear on the Gear Shaper as it is a spur gear, and the cutting of a spur gear is simplicity itself. Ask any owner of the Gear Shaper.

It is no exaggeration to say, therefore, that the Fellows Helical Gear Shaper has taken the "H—l" out of Helical and the "Myst" out of Mystery.

Don't fuss and worry along with the "old methods" any longer. There is a better way—the Gear Shaper way. Write now for our booklet, "The Fellows Helical Gear Shaper," which explains this most interesting machine.

COMPANY, Springfield, Vermont, U.S.A.

Paris, France, and Spain; Milan, Italy; Yokohama, Japan; Calcutta, India.



Few Concerns Demand More of Hobbing Machines than the Gear Manufacturers

Foote Bros. Gear & Machine Company, Chicago, Ill., maker of high-grade gears, uses Gould & Eberhardt Gear Hobbers; gives them hard service and finds them satisfactory from every standpoint. Hobbing these 36-degree, 52′ spiral, 75-tooth, 2½-pitch, 3″ face steel gears, which are bolted together to make herring-bone gears, gives a fair idea of what these machines are doing. The fact that Foote Bros. find six "Gould & Eberhardts" a profitable investment tells its own story of efficiency.

G & E Gear Hobbers are rigid, rapid, accurate, durable machines—therefore profitable. Let us tell you more about them.

GOULD & EBERHARDT

"HIGH DUTY" SHAPERS
AUTOMATIC GEAR AND RACK CUTTING MACHINERY

ESTABLISHED 1833 NEWARK, N.J. U.S.A.

"OHIO" SHAPERS



Always Busy

For more than two years "Rush" has been the commonest sign throughout the Holmes Manufacturing Company's plant at Shelton, Conn., where the accompanying photograph was taken—and truly remarkable are the number of so-marked jobs that have found their way to this concern's two "Ohio" Shapers.

The work varies greatly. One of the machines in the picture is cutting a keyway in a set of formed cutters, the other is machining a dovetailed slide for a fixture. The next job may be large jig castings and gear racks; but no matter what they are, the "Ohio" Shapers are expected to be ready, and if experience counts for anything, they certainly will be.

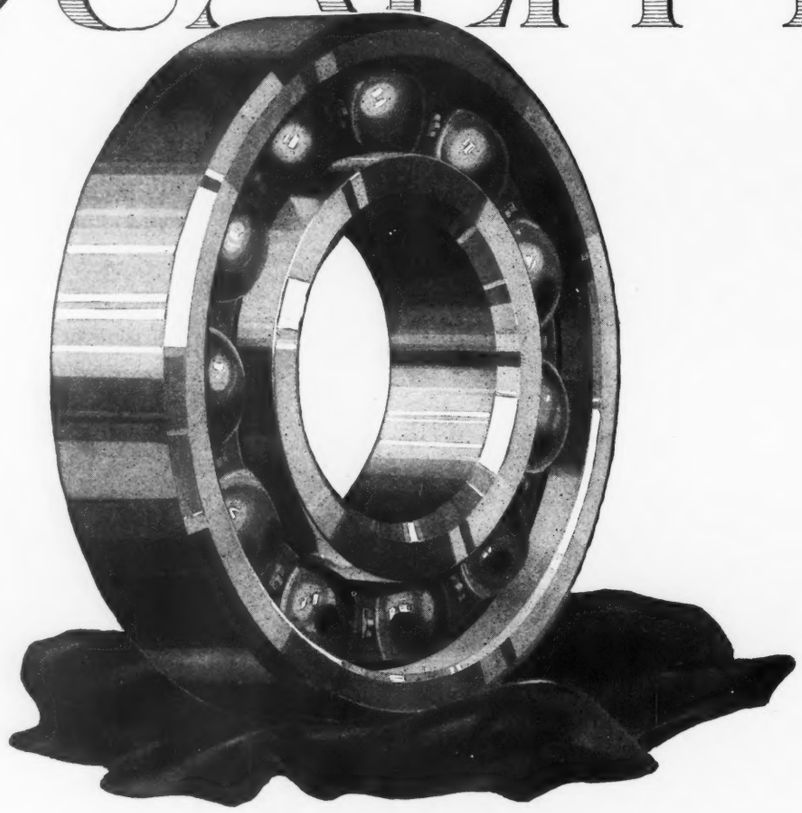
If you are looking for a machine you can keep busy ***always,*** a machine you know will be equal to whatever you give it, investigate the "Ohio." Start right now.

OHIO MACHINE TOOL COMPANY

KENTON Planers and Shapers Since 1887 **OHIO, U. S. A.**

Chicago, Federal Machinery Sales Co.; Toledo, Coghlin Machinery & Supply Co.; Cleveland, W. M. Pattison Supply Co.; Detroit, English-Miller Machinery Co.; Pittsburgh, Laughlin-Barney Machinery Co.; Buffalo, Laird Machinery Co.; Syracuse, H. A. Smith Machinery Co.; Philadelphia, Eastern Machinery & Equipment Co.; New York, Garvin Machinery Co.; Providence, Brownell Machinery Co.; Hartford, Conn., Putnam & Smith; Boston, Factory & Mill Supply Co.; Baltimore, Edwin L. Stringer; Minneapolis, Irvine Sales Co.; Huntington, W. Va., Banks Supply Co.; Omaha, Neb., Sunderland Machinery & Supply Co.; Montreal, Que., Standard Mchy. & Supplies Co.; Grand Rapids, Mich., McMullen Mchy. Co.; New Orleans, La., P. H. McArdle; Ottawa, Ont., General Supply Co. of Canada; St. Louis, Mo., Colcord-Wright Machinery Supply Co.; Tacoma, Wash., Sterling Machinery Co.; Portland, Ore., Pacific Engineering & Equipment Co.; General Machinery & Supply Co., San Francisco, Cal.; Gaston, Williams, Wigmore, France, England, Japan, China, Italy; Stokvis-Zonen, Petrograd.

QUALITY



New Departure Ball Bearings

Here are a few of many reasons for the QUALITY of this ball bearing:

Because it is of chrome alloy steel tubing specially made for us and *the best that money and skill can produce.*

Because our manufacturing processes exact dimensions that are accurate to a ten-thousandth part of an inch or *one-thirtieth the thickness of a human hair.*

Because each bearing is tested seventy-eight times during its development by precise instruments that assure maximum quality and accuracy.

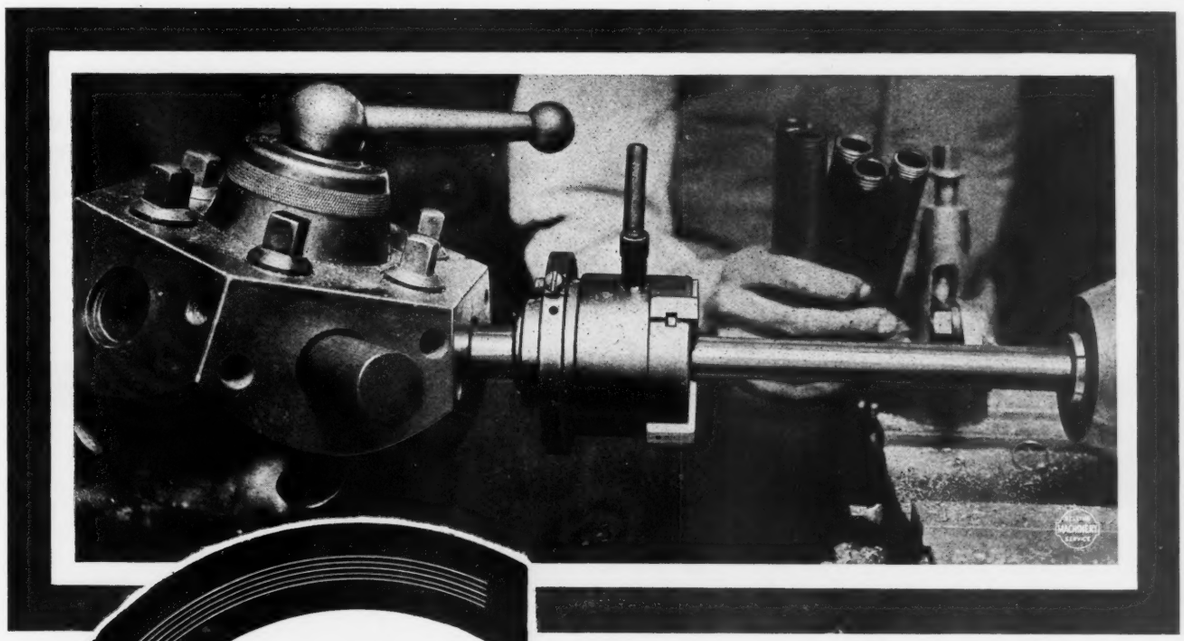
Because the steel balls are made by ourselves from the best chrome alloy steel procurable and are insistently tested for strength, sphericity and uniformity of size.

The quality of New Departure ball bearings is the reason for their extensive use in automobiles, motor trucks, aeroplanes and all kinds of machinery.

THE NEW DEPARTURE MANUFACTURING COMPANY, BRISTOL, CONN.

Conrad Patent Licensee.

346-A



Geometric Die Heads



In the past four years, the Universal Tool Company of Springfield, Mass. has used Geometric Die Heads—1/2 to 1½ inch range—and reports that one set of chasers lasts a year.

The particular operation shown is threading brass hush tubes a distance of 1/2 inch. A "D" Geometric Pipe Threading Die is used and production runs 200 pieces per hour—1,000 between grinds.

For Any Machine

For All Screw Threading Operations

Geometric Die Heads are designed to handle any screw threading operation, to be used on any machine and to stand hard, continuous service. Geometric threads have set new production standards and cut the cost of close limit duplicate manufacturing of threaded parts.

Our catalog gives further data on threading "Geometrically."

THE GEOMETRIC TOOL CO. Chicago Office: 627 W. Washington Blvd. **New Haven, Conn.**

REGULAR AGENTS: The Chas. A. Strelinger Co., Detroit, Mich.; Hill, Clarke & Co., Inc., Boston; Vandyck Churchill Co., New York and Philadelphia; Brown & Zortman Machinery Co., Pittsburgh, Pa.; The E. A. Kinsey Co., Cincinnati, O.; Strong, Carlisle & Hammond Co., Cleveland, O. PACIFIC COAST: General Machinery & Supply Co., San Francisco, Cal.; Smith-Booth-Usher Co., Los Angeles, Cal.; Perine Mchy. Co., Inc., Seattle, Wash. CANADA: The A. R. Williams Machinery Co., Ltd., Toronto, Winnipeg and St. John, N. B.; Williams & Wilson, Ltd., Montreal. FOREIGN AGENTS: Chas. Churchill & Co., Ltd., London, Birmingham, Manchester, Newcastle-on-Tyne, Glasgow. E. Isbecque & Co., Antwerp and Brussels, Belgium. V. Lowener's Maskinforretning, Sverre Mohn, Norway. Bevan & Edwards Pty., Ltd., Melbourne, and White & Rae, Sydney, Australia. Andrews & George, Tokyo, Japan. Also all manufacturers of Screw Machines and Turret Lathes.

HEALD Satisfaction

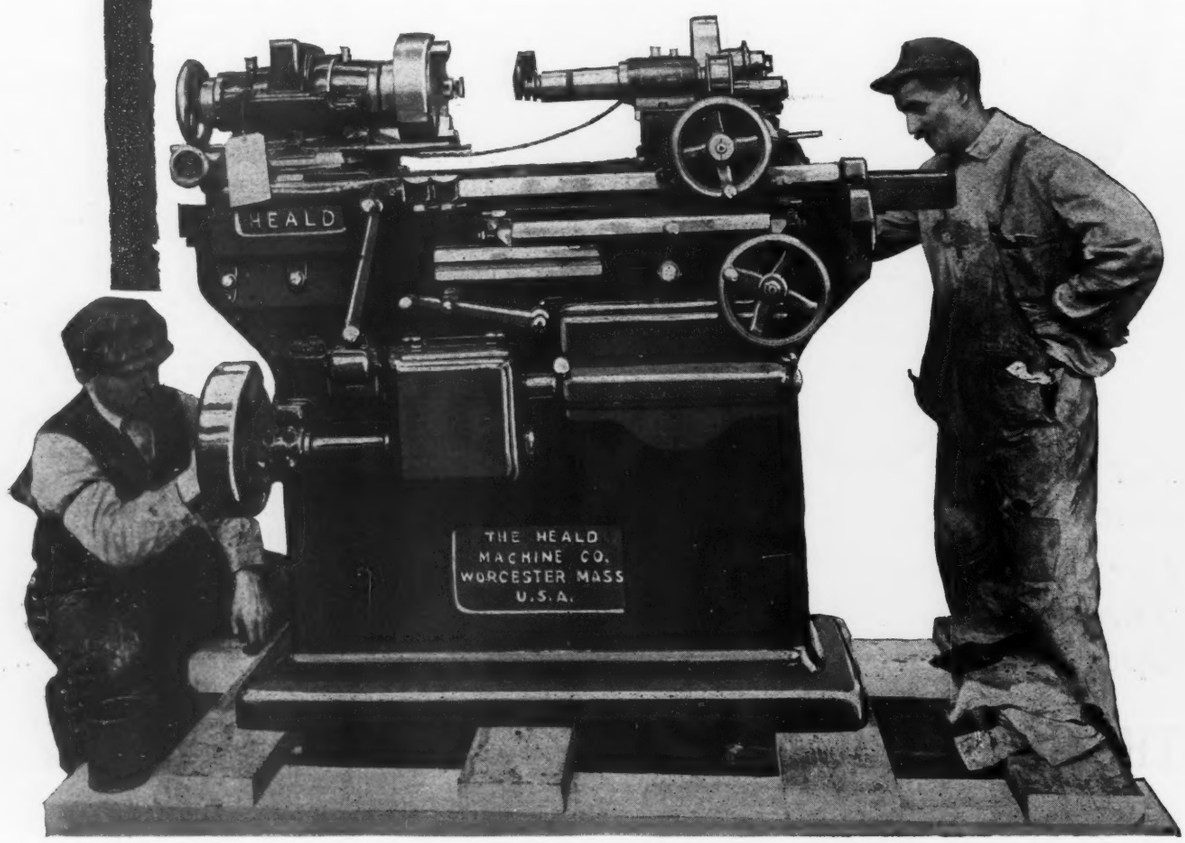
Here is machine No. 2000 of the HEALD STYLE No. 70 INTERNAL GRINDER.

On the opposite page the number plate shows very plainly, just to the right of the inspector's tag.

The painters were "caught in the act" of putting the finishing touches to the machine, so that its general appearance will measure up to the high grade workmanship in its construction.

Since the photograph was taken, the serial numbers have run above 2,200. This tremendous number of machines indicates clearly the satisfaction given to customers, wherever these machines are installed.

Repeat orders have formed a large proportion of this great output of grinders and it should be apparent to everyone that repeat



Given—Over 2,200 Sold

orders are not usually placed with any concern unless the original order measures up to the requirements of the work and the expectations of the buyer.

Communicate with our nearest Branch Office for full particulars on this DEPENDABLE grinding machine.

THE HEALD MACHINE COMPANY

NEW YORK, 839 Singer Bldg.
DETROIT, 911 Majestic Bldg.
PHILADELPHIA, 1408 Commonwealth Bldg.
CINCINNATI, 311 Provident Bank Bldg.
CHICAGO, 24 So. Jefferson Street
CLEVELAND, 710 Engineers Bldg.

WORKS: WORCESTER, MASS., U. S. A.

PACIFIC COAST AGENTS: Eccles & Smith Co., San Francisco and Portland. Smith-Booth-Usher Co., Los Angeles.

FOREIGN AGENTS: Alfred Herbert, Ltd., England, Italy, France, Switzerland, Spain and Portugal. F. W. Horne & Co., Japan.



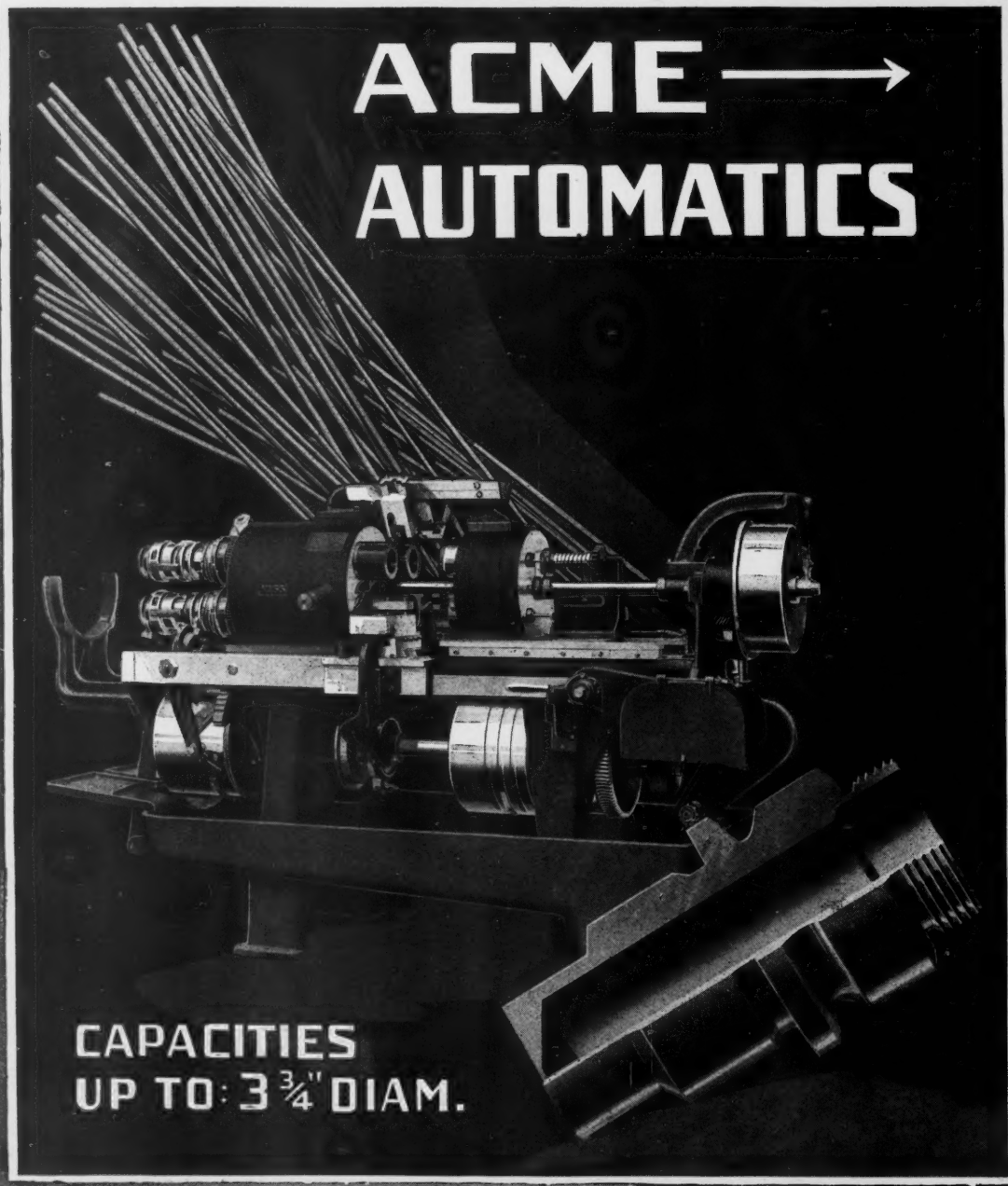
THE NATIONAL

CLEVELAND OHIO

NEW YORK ~ BOSTON ~ CHICAGO

NAYCO

ACME → AUTOMATICS



CAPACITIES
UP TO: 3 3/4" DIAM.

AT CLEVELAND: ACME AUTOMATICS & AUXILIARY SCREW MACHINES · AUTOMATIC THREADING DIES & TAPS · SCREW PRODUCTS

ACME COMPANY

WINDSOR VERMONT

DETROIT-ATLANTA-SAN FRANCISCO

NAMCO

BETWEEN THE RAW MATERIAL AND THE FINISHED PRODUCT

UPON the staunchness of machine tool depends the quality of the product.

The time required for the work is most important.

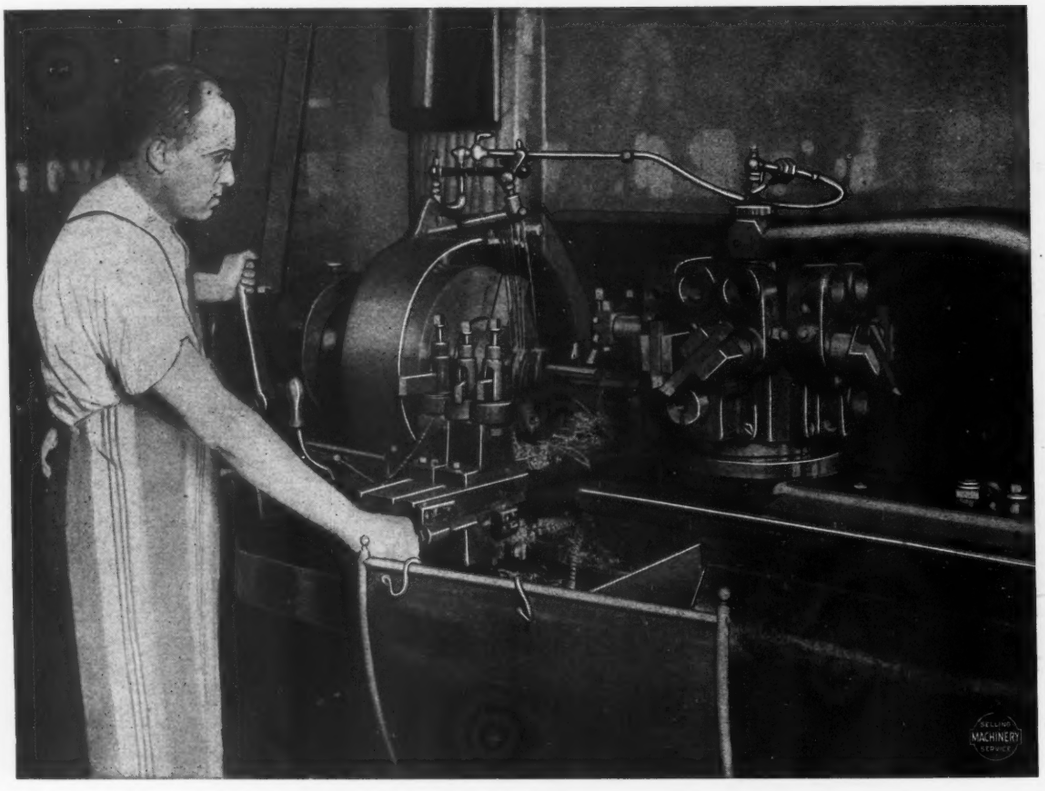
Production of duplicate parts on Acme Automatic Screw Machines means

—reduction of secondary operations;
—less dependence on a limited labor supply;
—up-to-date production schedules;
—economical production and the lowest cost per piece.

Twenty years' experience has proved their value as REAL PRODUCERS.

Complete Data on receipt of Samples or Blue Prints

AT WINDSOR: GRIDLEY AUTOMATICS· SINGLE SPINDLE TURRET LATHES & MULTIPLE SPINDLE SCREW MACH'S· PISTON & RING MACH'S



There are
Ninety-two
POTTER & JOHNSTON Automatics
in the Morrow Plant

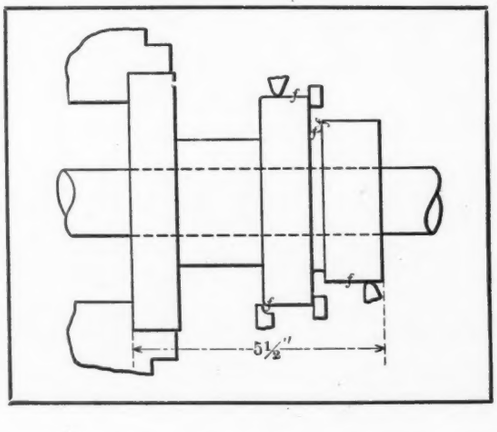
You can safely follow the lead of the Morrow Manufacturing Company and buy Potter & Johnston Automatics. Let us send you the catalogue.

Potter & Johnston
Pawtucket, Rhode Island

OFFICES AND REPRESENTATIVES: Great Britain, France, Italy, Belgium, Switzerland, Spain and Portugal: 68 Avenue de la Grand Armee, Paris, J. Ryan, Manager. New York Office: Fulton Bldg., 50 Church St., Walter H. Foster Co., Managers. Detroit Office: Modern Machinery and Engineering Co., 1514 Ford Bldg. Chicago Office: 4213 Sheridan Road, Chas. H. Shaw, Manager. Toronto Office: 1501 Royal Bank Bldg., E. C. Roelofson, Manager. FOREIGN AGENTS: Chas. Churchill & Co., Ltd., London, Birmingham, Manchester and Newcastle-on-Tyne, England, and Glasgow, Scotland. Ercole Vaghi, Corso Porta, Nouva 34, Milan, Italy.

They are all doing creditable work—the job shown herewith was selected because it was typical, not exceptional.

The part is a transmission gear blank, made from nickel steel. The first operation, bore, ream and face the large end and turn the largest and smallest diameters, is also a Potter & Johnston job; but the machine shown above is performing the second operation. The blank is chucked, the two diameters are turned, one of the diameters is rounded and the neck is rough and finish turned—all in eight minutes. The first operation is performed in eight minutes also—making a total of sixteen minutes for the completed piece.



STANDARD

SHIELD BRAND MILLING CUTTERS







STANDARD Shield Brand Milling Cutters meet all requirements. Made with the experience of thirty-six years behind them, in a plant equipped with every modern appliance.

Shield Brand Cutters are made from either carbon or high speed steel in all stock shapes and sizes and in special shapes to meet individual requirements.

Stock tools are carried at the factory and the New York and Chicago salesrooms.

Send for further information.

Look for the Shield.

THE STANDARD TOOL CO.

CLEVELAND, OHIO

New York, 94 Reade St. Chicago, 552 W. Washington Blvd.

London—Burton, Griffiths & Co., Ltd. Paris—Burton Fils.
Copenhagen—Nienstaedt & Co. Geneva—J. Lambercier & Cie.
Tokio—The F. W. Horne Co.

Michigan Tool Co

Milling Cutters, Hobs and Special Tools

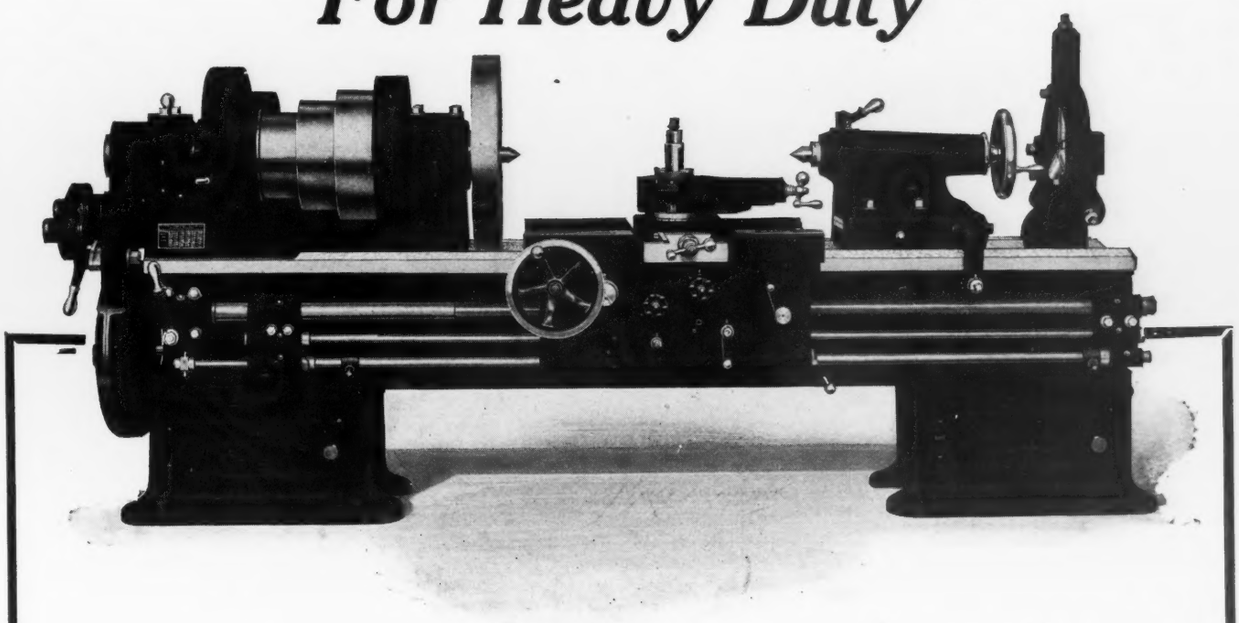
TOOLS THAT WILL SATISFY MODERN DEMANDS

MICHIGAN TOOL COMPANY
DETROIT, MICH., U. S. A.



HIGH POWER

For Heavy Duty



THE SPRINGFIELD "IDEAL" HEAVY PATTERN ENGINE LATHE

A lathe possessing all the distinctive qualities of the "Ideal" type and several special features essential to a machine of unusual power. This lathe will respond to the heaviest demands for speed, endurance and accuracy—in tool room or manufacturing plant.

Regular equipment includes three step cone, rapid change gear device (patented) automatic stop in either direction, recessed tailstock, steady and friction countershaft. This lathe is built in 24 and 26 inch swing and can be supplied with motor drive.

Circular No. 137 contains full information regarding dimensions, weights, special attachments, etc.

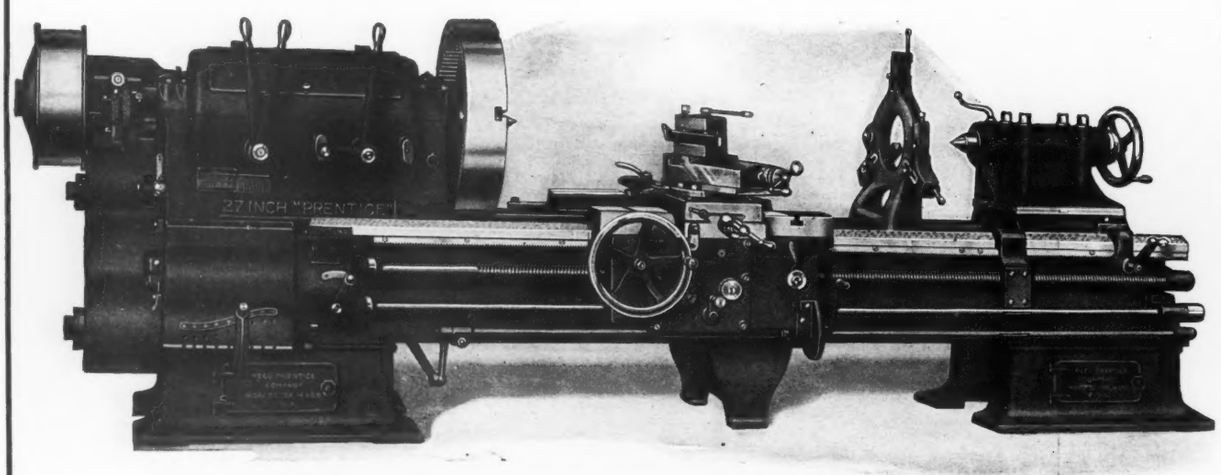
The Springfield Machine Tool Company

Manufacturers of Springfield Lathes and Shapers

631 Southern Avenue **Springfield, Ohio, U. S. A.**

REED-PRENTICE COMPANY

WORCESTER MASS. U.S.A.



27 INCH GEARED HEAD "PRENTICE"

REED-PRENTICE COMPANY

WORCESTER MASS. U.S.A.

A Suggestion.

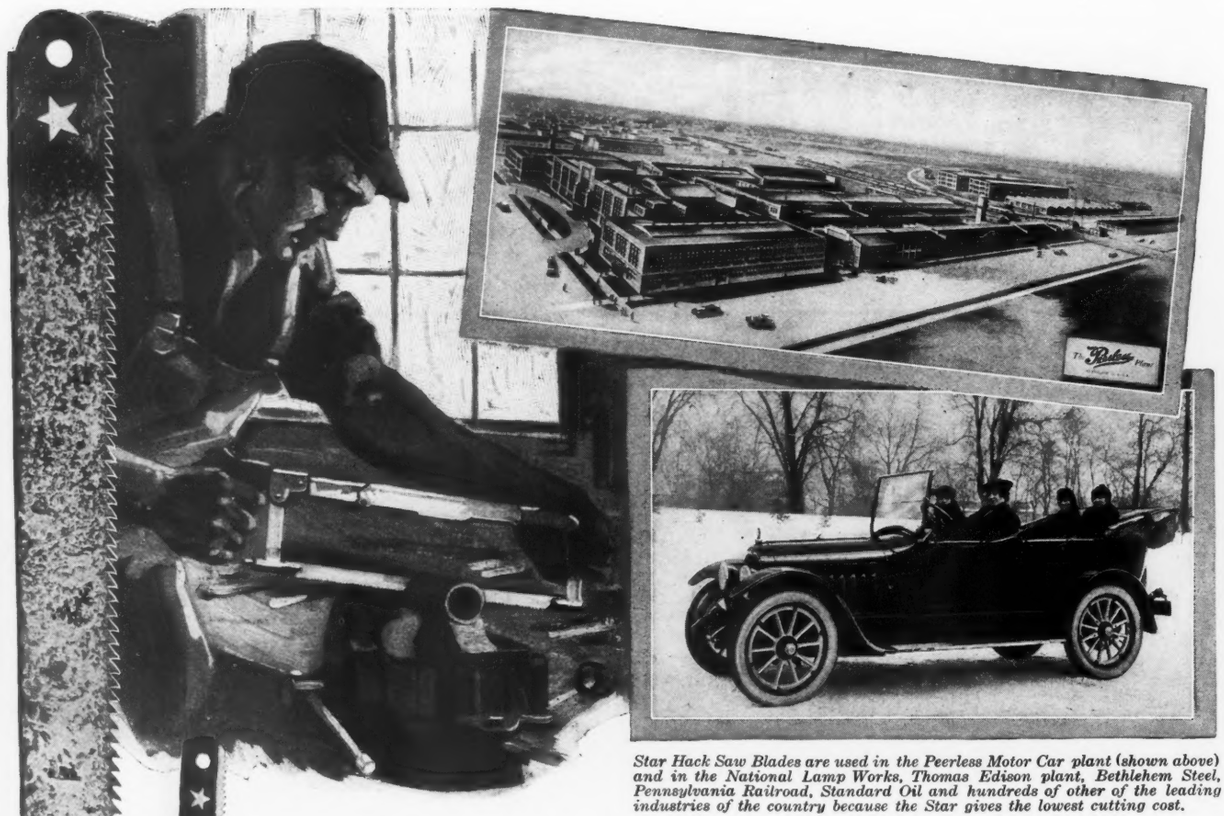
YOUR WORK MAY OFTEN CALL FOR A LATHE OF LARGE SWING, YET SUCH A MACHINE WOULD NOT AS A RULE BE CONVENIENT OR ECONOMICAL TO USE ON SMALL WORK.

HERE IS A LATHE WITH A 30 INCH SWING AND A 12 SPEED HEAD WHICH WILL DO YOUR BIG WORK BETTER AND FASTER.

THE SPEED, FEED AND THREAD-CUTTING CHANGES ARE SO QUICKLY AND EASILY MANIPULATED THAT, WITH THE GREAT NUMBER OF CHANGES AVAILABLE, YOU WILL BE ABLE TO ALLOT SMALL WORK TO IT PROFITABLY.

WE WILL BE GLAD TO SEND YOU INFORMATION ON THIS LATHE.

MANNING, MAXWELL & MOORE, INC.
ALLIED MACHINERY CO. OF AMERICA
FENWICK FRERES
CANADIAN FAIRBANKS-MORSE CO., LTD.



Star Hack Saw Blades are used in the Peerless Motor Car plant (shown above) and in the National Lamp Works, Thomas Edison plant, Bethlehem Steel, Pennsylvania Railroad, Standard Oil and hundreds of other of the leading industries of the country because the Star gives the lowest cutting cost.

What Do You Get When You Buy Hack Saws?

Don't forget that when you buy hack saws you don't buy blades at all in last analysis. You buy results—the greatest number of cuts at the lowest price.

Fast-cutting blades that break easily are expensive, and non-breakable blades that cut slowly are expensive too.

Star hack saw blades are neither one because they are fast-cutting blades that stand up and last. They give you the greatest production at the lowest cost because they are quick-cutting and tough too. You can't break a regular Star blade on ordinary work, but if there is unusual strain we have a fast-cutting flexible blade to fill the need.

And note this—when you buy the Star you don't have 150 or more sizes, gauges and pitches to select from. Every Star Saw is designed to cut a wide variety of materials. And any blade that needs a multiplicity of sizes is wrongly designed and inefficient or it would not need a half dozen saws to do the work of one.

When you are sawing by hand or machine you are usually cutting first one shape and material and then another. There is no chance to change saws every time. So the all-purpose Star Blade becomes a service necessity.

STAR HACK SAW BLADES

made of Tungsten Steel

Machine and Hand ***Flexible and All Hard***

In the Star Saw we have worked out a tooth shape, a steel mixture and a heat treatment that give us a standardized blade that will cut a wide variety of work without change.

The tooth on the Star Blade has an acute cutting angle and a three-way clearance that is entirely different from the V-shape of the ordinary hack saw tooth. That is why the Star Blade can cut all kinds of material, stand up under fast sawing and heavy work and keep on cutting at a rapid rate after the teeth are worn way down.

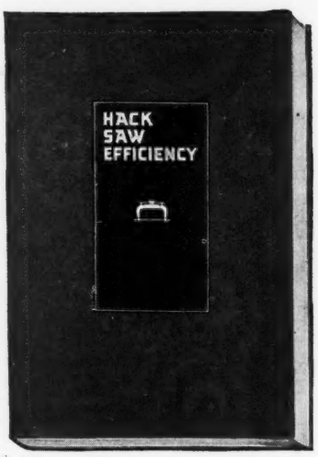
The special tungsten chromium steel mixture in the Star Blade makes it faster-cutting and our different heat treatment gives the Star a greater toughness.

In some cases our tests have shown that the Star lowers the cutting cost as much as 20 per cent as compared with other blades. In every case there was a substantial difference in favor of the Star.

Whatever your present cutting costs, if you are using another saw you can make a substantial saving in using the Star Blade, as a comparison will readily demonstrate.

Write us the kind of cutting you are doing and the saw you are using and we will show you an easy way to make a hack saw comparison in the regular course of your work. Address the Engineering Department of the Millers Falls Co., 210 River St., Millers Falls, Mass.

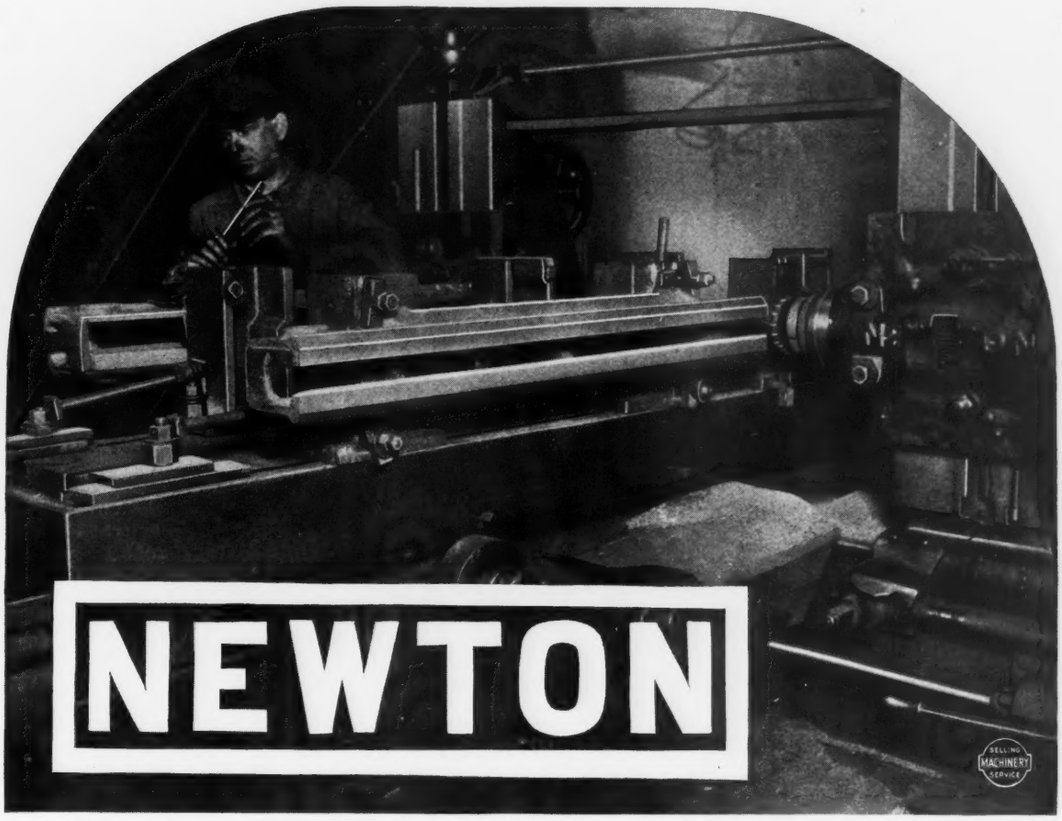
Send today for our "Hack Saw Efficiency" handbook. It contains more vital information about hack saws and their use than was ever put into a book before. Free on request to every hack saw user.



Manufactured By
CLEMSON BROS. INC.
MIDDLETOWN, NEW YORK

Sole Distributors
MILLERS FALLS CO.
MILLERS FALLS, MASS.

This NEWTON Duplex Milling Machine Has a Busy Life



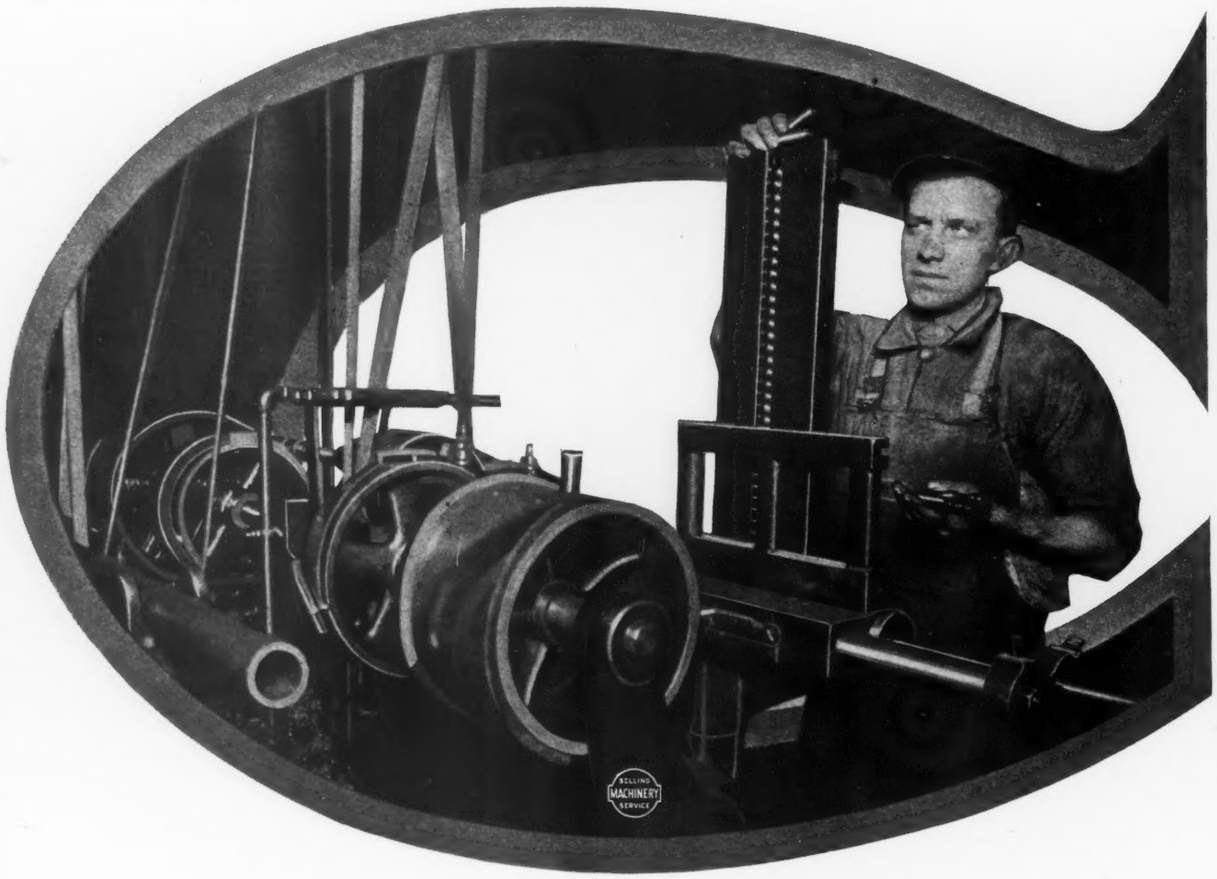
The Frick Company, Waynesboro, Pa., installed it about eight years ago—and it has been kept busy constantly ever since, on a variety of parts for agricultural and refrigerating machinery, gas and steam engines, tractors, saw mills and other machinery. The job shown is a saw-mill head block on which several operations are performed on from four to eight castings at a time. The two heads, each independently operated, give this machine its name "Duplex" and keep its operator busy setting up work. Let us tell you more about it.

Rotary Planing Machines, Slotting, Boring and Cold Saw Cutting-off Machines, Horizontal and Vertical Milling Machines and Portable Boring, Drilling and Milling Machines

Complete Catalog on Request

NEWTON MACHINE TOOL WORKS, INC.

23d and Vine Streets **PHILADELPHIA, U. S. A.**



The Cleveland Automatic

Empties That Magazine in Ten Minutes

The Buffalo Forge Company, Buffalo, N. Y., makes nuts, bushings, shafts, studs and bolts in large quantities—and uses the Cleveland Automatic to help to do it profitably.

The operator is shown loading the magazine of a Cleveland Automatic with 5/8″ stud blanks, 3½ inches long, which are threaded for a length of 3/4″ and delivered from the machine at 27-second intervals. It keeps the operator on the jump to maintain the magazine supply.

Cleveland Automatic speed is more remarkable when the quality of product is taken into consideration.

Can not *your* small part production be improved as to speed, quality or both?

contains 31 essays by the man who built the Cleveland Automatic. It is not a circular on the "Cleveland." Special literature takes care of that. Send for both.

CLEVELAND AUTOMATIC MACHINE COMPANY

CLEVELAND, OHIO, U. S. A.

EASTERN REPRESENTATIVES: J. B. Anderson, 211 Gowan Ave., Mt. Airy, Philadelphia. WESTERN REPRESENTATIVE: Herbert E. Nunn, 565 West Washington St., Chicago. FOREIGN REPRESENTATIVES: Chas. Churchill & Co., Ltd., London, Manchester, Birmingham, Newcastle-on-Tyne and Glasgow.



TRY A NEW WILLARD

On Approval

The proof of the pudding and the test of a machine are much the same. Both must be tried to demonstrate their worth.

Here's your chance to try out an accurate and productive High Power Engine Lathe—with readily controlled quick change mechanism of unusually wide and varied range, and durability assured by broad, pan style headstock, chilled V's, 65 point carbon spindle, steel gears, taper gibbed sliding surfaces and substantial reinforcements at every point of strain.

If you are already familiar with the sterling merits of the old "Willard" a detailed description of the "improvements" embodied in the new model will be sufficient; but to all "Missourians" whose work comes within its range, the above offer should have a strong appeal.

Details of machine and offer on request.

Three Styles:

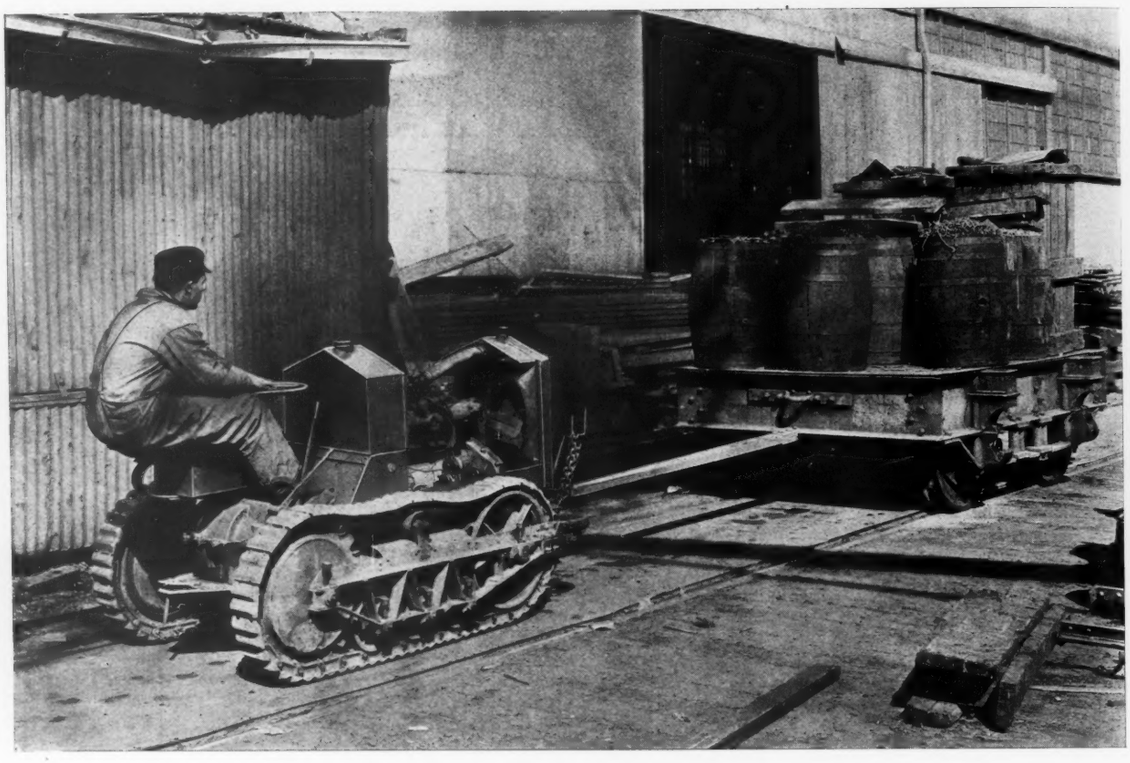
Standard Gap and Toolroom.

5, 6, 7, 8 and 10 foot beds.

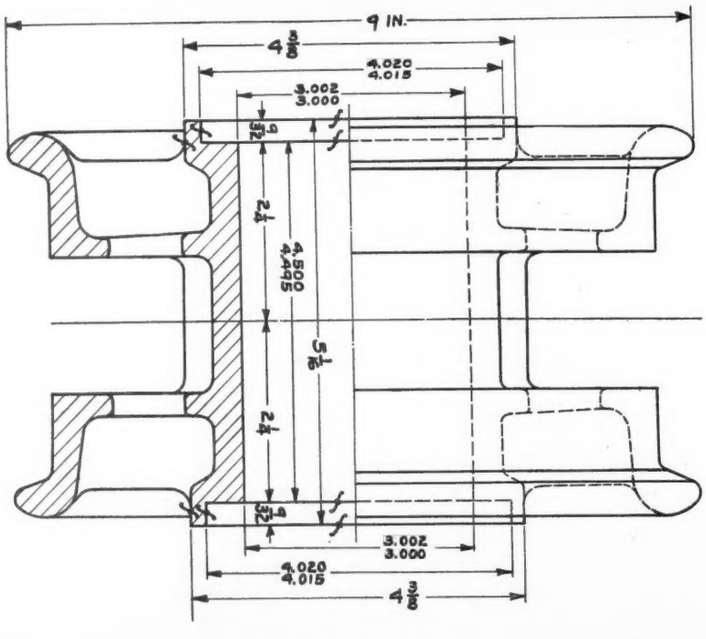
The Willard Machine Tool Co.

CINCINNATI OHIO, U.S.A.

The Cleveland Tractor and



Cleveland Tractor Company Tractor

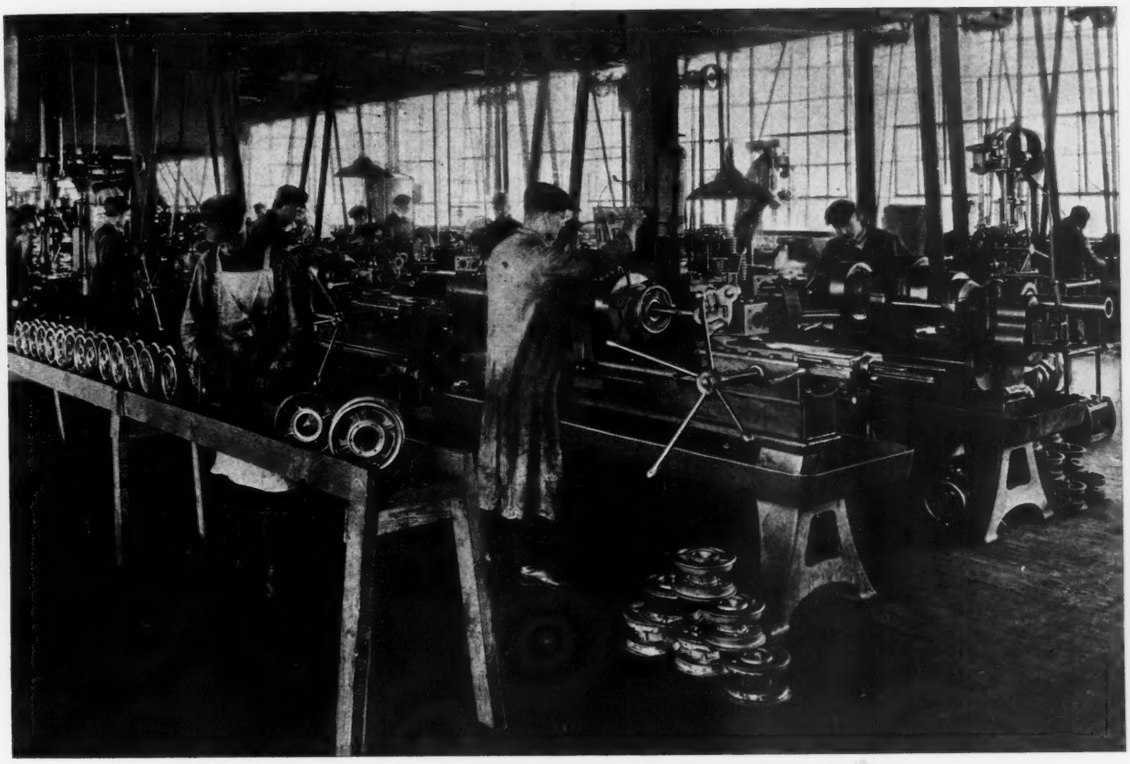


THE WARNER & SWASEY

TURRET LATHES - TURRET SCREW MACHINES—BRASS WORKING MACHINE TOOLS

New York Office—Singer Bldg. Boston Office—Oliver Bldg. Buffalo Office—Iroquois Bldg.
Detroit Office—Ford Bldg. Chicago Office and Show Room—618-622 Washington Blvd.

Warner & Swasey Machines



Some of the Warner & Swasey Screw Machines in their Plant

The Cleveland Tractor Company, Cleveland, had to get busy with dependable tools to fill orders for their tractors. With the shortage of labor the farmers were in need of their machines and industrial plants wanted the most efficient means for transferring their work.

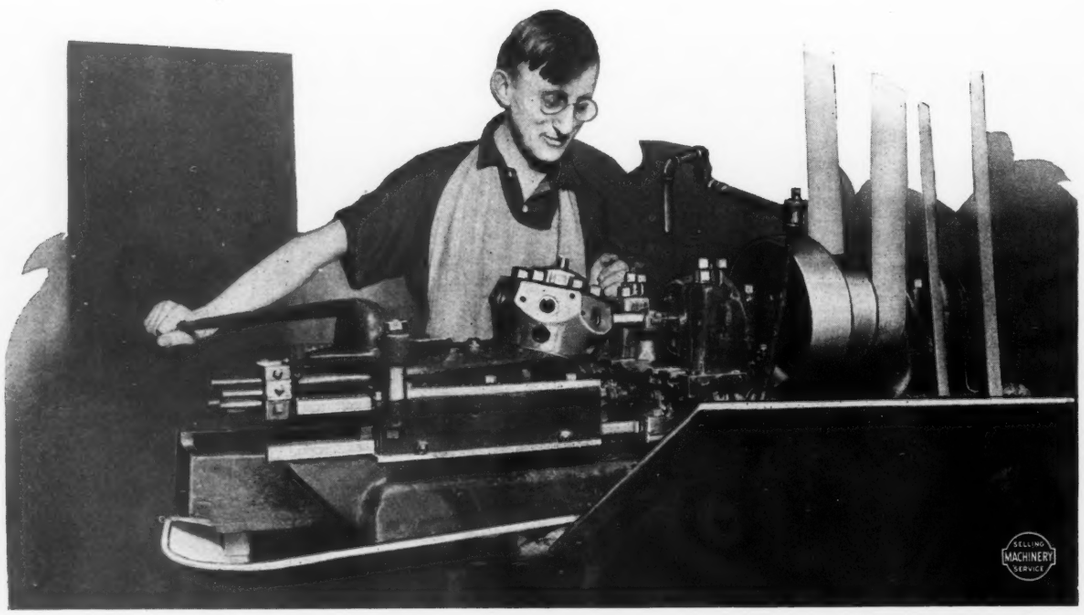
This lower truck wheel is only one of the many pieces produced better and faster on Warner & Swasey Machines. The time on another make of Screw Machine was 200 in 11 hours. A W. & S. No. 6 turns out 300 in the same time—*a saving of fifty per cent.*

If your work is less than 21½ inches in swing or 4½ inches in the bar, a Warner & Swasey machine is ready to help you out. The tools are wide in range and will let you get busy without delays or expense of special tooling.

Send us your problems for comparison with present output or for help in planning your new work.

COMPANY, Cleveland, Ohio, U. S. A.

FOREIGN AGENTS: Chas. Churchill & Co., Ltd., London, Birmingham, Manchester, Newcastle-on-Tyne and Glasgow. Allied Machinery Company, Paris and Turin. Van Rietschoten & Houwens, Rotterdam. Yamatake & Co., Tokio. Benson Brothers, Sydney and Melbourne. A. Asher Smith, Sydney. A. R. Williams Machinery Co., Ltd., Toronto, St. John, Winnipeg and Vancouver. Williams & Wilson, Ltd., Montreal.



THE TILTED TURRET

A CLEAR TRACK FOR THE STOCK

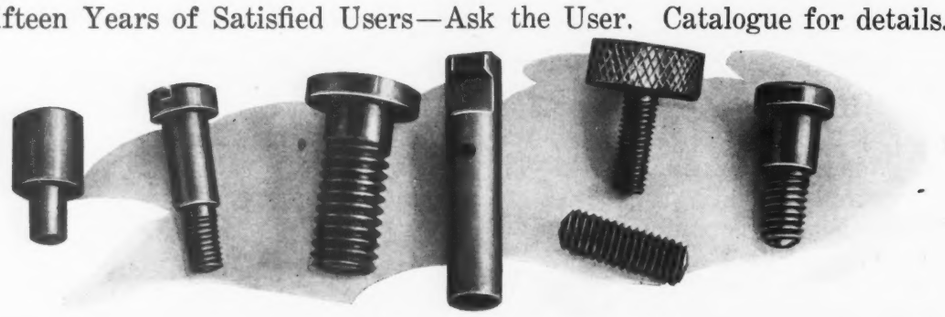
Selected Because of the Facility With Which It Can Be Changed From One Job to Another

Where machines are built in small lots—typesetting machines and similar intricate, high grade automatics—frequent set-ups and changes make heavy inroads on production costs.

The Unitype Company of Jersey City—after comprehensive experiments—found the solution of this problem in the quick change features of the Tilted Turret. They likewise killed two birds with one stone when installing it, because with their rigid system of inspection, any piece with a variation of more than .0005 plus or minus would be rejected, and the accuracy of the Tilted Turret Lathe has practically eliminated rejects in their plant.

Above is shown the machine in action—below some of the parts which insure the perfect functioning of the Unitype Company's machines.

Fifteen Years of Satisfied Users—Ask the User. Catalogue for details.



WOOD TURRET MACHINE CO.

BRAZIL INDIANA U.S.A.

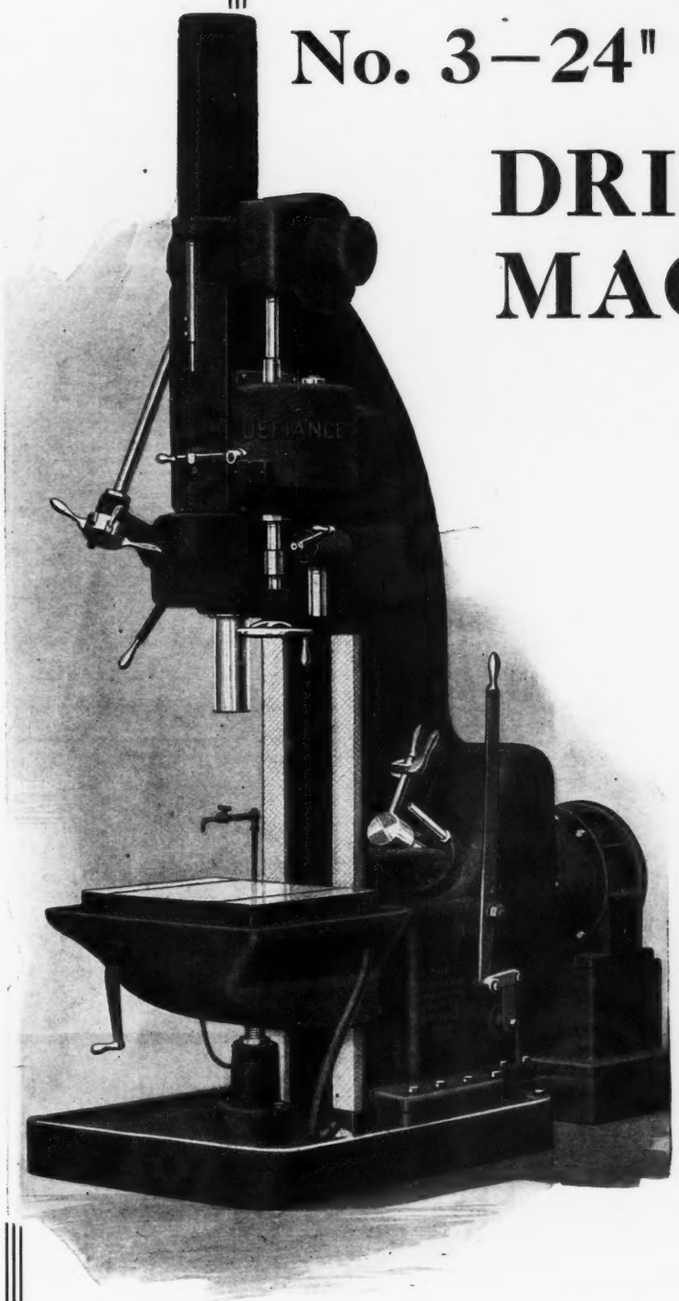
DOMESTIC AGENTS: Frevert Machinery Co., New York, N. Y.; Lynd-Farquhar Co., Boston, Mass.; Hill, Clarke & Co. of Chicago, Chicago, Ill.; Swind Machinery Co., Philadelphia, Pa.; Wm. K. Stamets, Pittsburgh, Pa.; Syracuse Supply Co., Syracuse, Buffalo and Rochester, N. Y.; Aumen Machinery Co., Baltimore, Md.; Brownell Machinery Co., Providence, R. I.; English & Miller Machinery Co., Detroit, Mich.; Brandes Machinery Co., Cleveland, O.; Osborne & Sexton Machinery Co., Columbus, O.

Foreign Countries Write Factory Direct.

DEFIANCE

No. 3—24" Heavy Service

DRILLING MACHINE



Its Purpose is Big Production

Every unit of this most modern Heavy Service Drilling Machine has been subjected to severe tests rarely encountered in shop practice. Every unit has been made to stand the rough usage and strain that production tool operators demand. It drives a 3″ high speed drill in solid steel with an unusual factor of safety.

The drive shafts are fitted with Hyatt roller bearings, and the spindle thrusts are taken by SKF thrust bearings. The spindle is driven close to the nose through helical gears arranged with ball bearings to eliminate thrust to the spindle gear and keys; this design positively prevents torsion, and effects a smooth, powerful drive.

The spindle, speed and feed mechanisms are tightly housed and oiled by a treble system consisting of a splash, force feed and gravity flow combined. A quick roll-in gear method is used in selecting speeds, which eliminates trouble common to change gear devices. The foregoing, together with other important features, are illustrated and described in a circular covering this machine.

THE DEFIANCE MACHINE WORKS

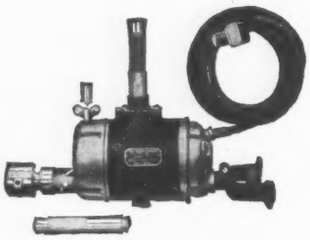
Designers and Builders of

Precision-Production Machine Tools

DEFIANCE — **OHIO, U. S. A.**

NEW YORK — **LONDON**

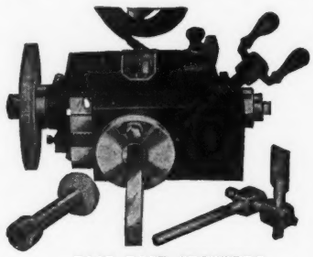
Cut Your Costs—"CINCINNATI ELECTRICS" will do it



HAND OR BREAST DRILLS
¼", ⅜", ½", ¾" capacities. Weight from 7 pounds up. Ball and thrust bearings. Gears run in grease. Single and two speeds.



COMBINATION BENCH DRILLING STAND WITH DETACHABLE ELECTRIC DRILL
Made in various types, to carry drills from ½" to 1¼" capacities.

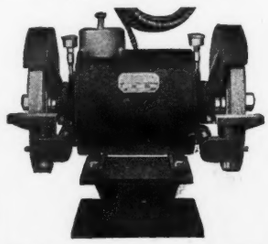


TOOL POST GRINDERS
¼ to 3 H. P. Weight from 16 pounds up. Free hand feed. Bearings adjustable to wear. Horizontal and vertical feeds. Different types for all purposes.



HAND AERIAL GRINDER
For cleaning castings or surface work of any kind. Made in four sizes, ¼ to 2 H. P. Weight from 18 pounds up. Guaranteed for hard usage.

SPECIAL FEATURES
Air cooled. Ball and Thrust Bearings. All working parts hardened. Overload Allowanee. Guaranteed Mechanically and Electrically.



BENCH GRINDER OR BUFFER
Five sizes, ¼ to to 3 H. P. Also Pedestal Floor Grinder, 1 to 3 H. P. Fully enclosed. Dirt- and dust-proof. Ball bearings.

CINCINNATI ELECTRICAL TOOL COMPANY

1501-3-5 Freeman Avenue **CINCINNATI, OHIO**

FOREIGN AGENTS, England: S. Wolfe & Co., London. **Australia:**. Parke & Lacey Co., Ltd., Sydney. **Norway:** V. Lowener, Christiania. **France:** R. S. Stokvis & Fils, Paris. **Holland:** R. S. Stokvis & Zonen, Ltd., Rotterdam. **Japan:** Yamatake & Co., Tokyo. **Spain:** American Machinery Syndicate, New York City.

New York Office, 50 Church Street **Stock and Service Department**

Don't Scrap a Set of Hartness Chasers because of the breakage of a single chaser; ***replace the broken chaser.***

It is only necessary to grind the set to uniformity.

Hartness Chasers Are Interchangeable

This Interchangeability of Hartness Chasers is possible because of our special method of manufacture.

JONES & LAMSON MACHINE COMPANY

Automatic Die Dept.

109 Queen Victoria St., London, Eng. **Springfield, Vermont, U. S. A.**

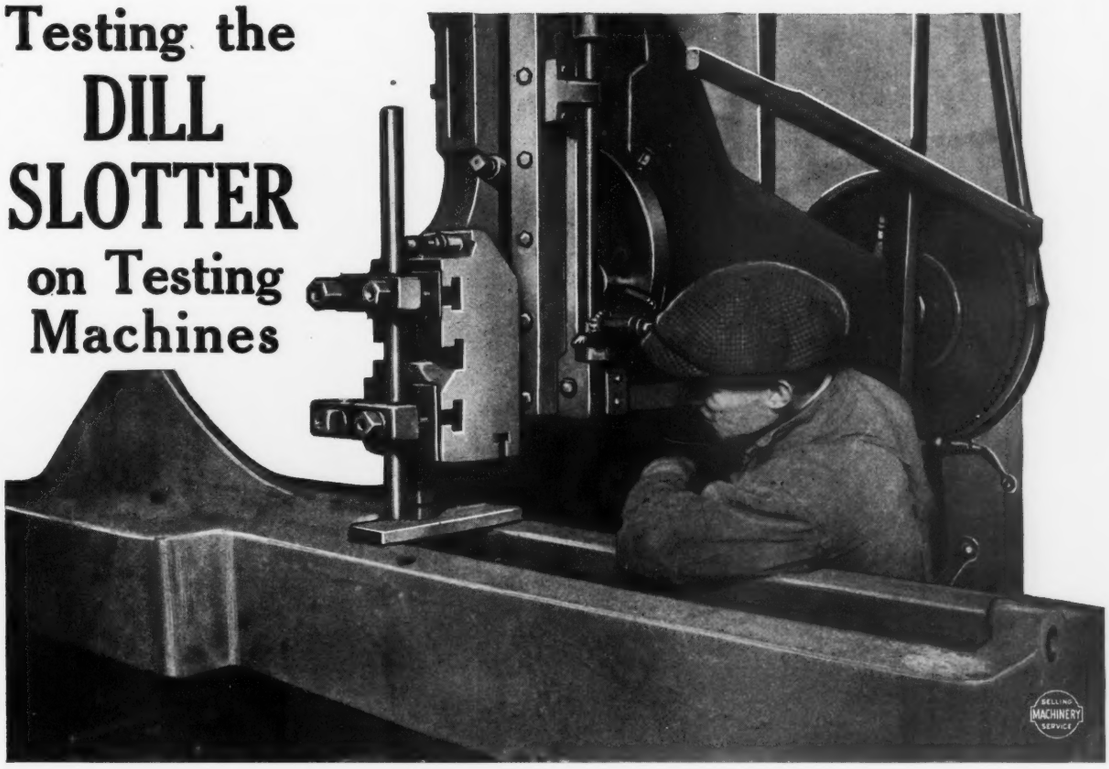
AMERICAN AGENTS FOR DIES AND CHASERS

Barwood-Richards Mchy. Co., Bourse Building, Philadelphia.
Boyer-Campbell Co., Detroit.
Carey Mchy. & Supply Co., Baltimore.
E. L. Essley Mchy. Co., Chicago, Milwaukee and Moline.
The E. A. Kinsey Co., Cincinnati and Indianapolis.
Machinists Supply Co., Pittsburgh.
Pacific Tool & Supply Co., San Francisco and Los Angeles.
The W. M. Pattison Supply Co., Cleveland.
Robinson, Cary & Sands Co., St. Paul and Duluth.

FOREIGN AGENTS

For France, Spain and Belgium: F. Auberty & Co., 91 Rue de Maubeuge, Paris.
For Holland: Spliethoff, Beeuwkes & Co., Rotterdam.
For Australia: McPherson's Pty., Melbourne.
For Argentina: Alsina & Cagnoni, Buenos Aires.

Testing the DILL SLOTTER on Testing Machines



The Tinius Olsen Testing Machine Company of Philadelphia makes machines that *must* be reliable. It stands to reason that the tools used in their construction must be equally reliable, for like begets like even in machine tool building.

As busy as, or more so than, any other machine in this plant is the Dill Slotter. It has been steadily "on the go" for the last twelve years and, by the looks of things, it's going to keep its successor out of a job for a long, long time.

Three principal features mark the Dill Slotter—it is absolutely dependable under all conditions; it is simple enough in handling its wide range of work to make it extremely profitable, and last, but perhaps most important in the average shop, it's hard to find a job it can't do—it's the substitute for special machinery nine times out of ten.

How far are you from here?

T. C. DILL MACHINE COMPANY

THE DILL SLOTTER PEOPLE

PHILADELPHIA **PENNSYLVANIA, U. S. A.**

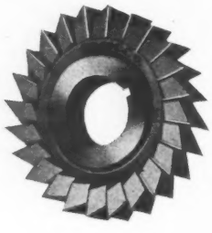
FOREIGN AGENTS: Coventry, London, Birmingham, Leeds, Manchester, Newcastle-on-Tyne and Glasgow; Alfred Herbert, Ltd. France: Alfred Herbert, Ltd. Italy: Alfred Herbert, Ltd. Japan: Alfred Herbert, Ltd, Yokohama. Germany and Austria: Heinrich Dreyer, Berlin, Germany. Holland: R. S. Stokvis & Zonen, Ltd., Rotterdam. Belgium: R. S. Stokvis & Fils S. A. Brussels.

BECKER



Milling Cutters

Increase the Efficiency of Any Milling Machine



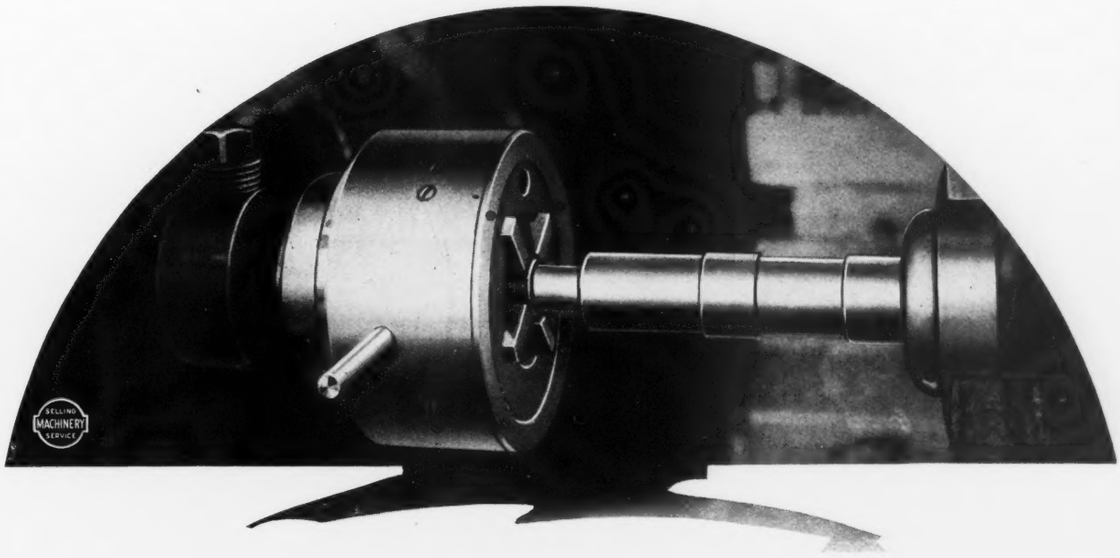
The efficiency of a milling machine depends largely on the quality and condition of its cutters. Becker Milling Cutters are designed to take big cuts without chatter, to stand up under hard, continuous service and to hold their cutting edges with a minimum of grinding. With ample chip clearance and the stamina which permits driving at full capacity, they increase the efficiency of any milling machine and cut production costs as well.

Stock list issued monthly. **Is your name on our mailing list?**

THE BECKER MILLING MACHINE CO.

HYDE PARK, BOSTON, MASS.

Detroit Branch, J. J. Loftus, Mgr., 529 Majestic Bldg.; The Whitman & Barnes Mfg. Co., 64 Reade Street, New York; H. A. Smith Machinery Company, Syracuse, N. Y.; W. M. Pattison Supply Company, Cleveland, Ohio; E. L. Essley Machinery Company, 551 Washington Blvd., Chicago, Ill.; New England Sales Agent, H. A. West, 10 High Street, Boston, Mass.



MODERN

Modern Die Heads

Cut Clean On Drop Forgings

Two characteristics identify the efficient self-opening die head, (1) it must hold to size under all conditions and not cut tapering threads, and (2) it must produce sharp, clean threads regardless of what the stock may be.

The photograph illustrates one of the most trying jobs that could come to a die head—the cutting of a 1″ 18-pitch thread for a length of 1¼″ on a drop steel forging to be used in automobile construction.

As a general rule no one likes to handle stock of this kind, but in the present instance the operator knows the Modern Die Head will perform the job *as usual.* He knows the chasers won't retreat.

If you have trouble in threading difficult materials, give the Modern Die Head a trial. You may be assured by the way it "came through" in other plants. Write us.

MODERN TOOL COMPANY, MAIN OFFICE AND WORKS SECOND AND STATE STS., **ERIE, PA.**

NEW YORK OFFICES, 50 Church Street and 2 Rector Street.
DETROIT OFFICE, 1223 Dime Bank Building. CHICAGO OFFICE, 32 North Clinton Street.
CINCINNATI OFFICE, 2 Greenwood Office Exchange. F. WESLEY PARKER, Export Manager, 2 Rector Street, New York.
Agencies in London, Paris, Stockholm, Barcelona, Milan.

TRADE W.F. & J.B. MARK

Complete Line

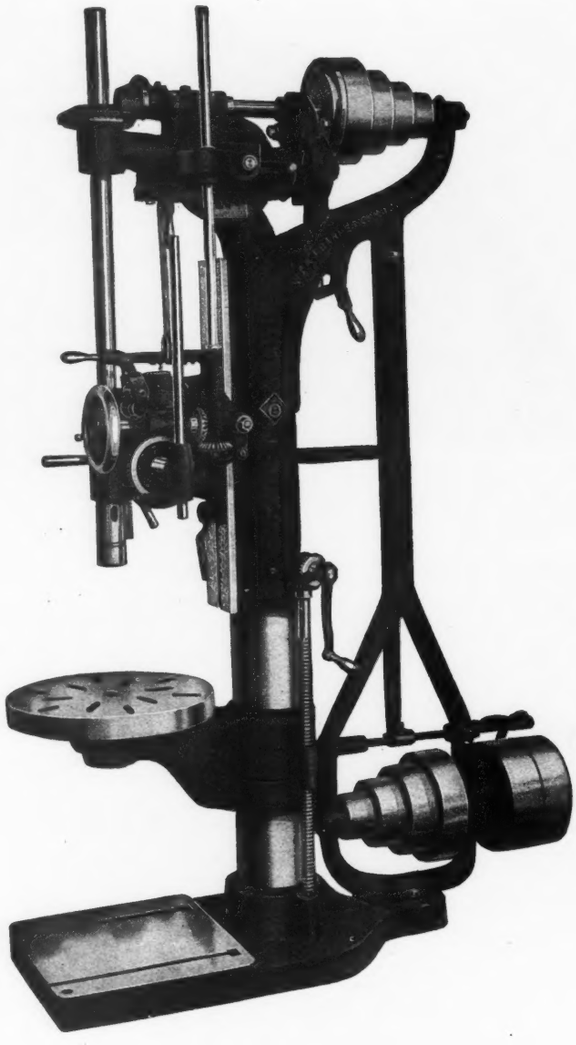
8-inch to 50-inch Swing

(With or without Tapping Attachment)

Upright Drills

Horizontal Drills

Gang Drills

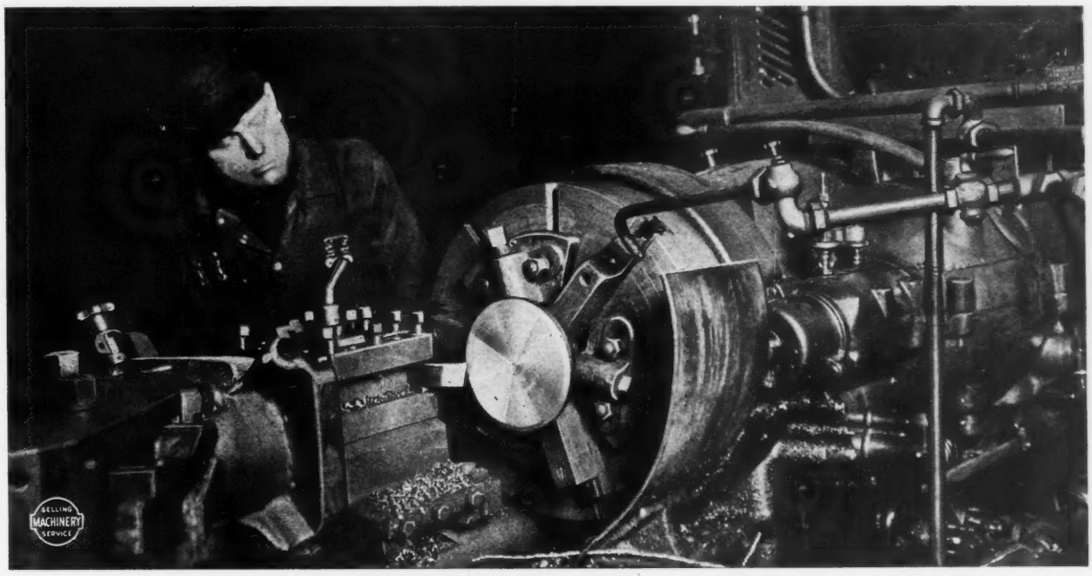


BARNES DRILLS

Accuracy
Convenience of Operation
Strength

MADE BY

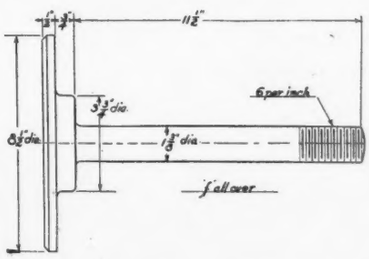
W. F. & John Barnes Company
231 Ruby Street
Rockford, Ill., U. S. A.



The Libby Lathe

and The Drive for More Locomotives

Story and pictures come from a large railroad shop in Pennsylvania where Libby Lathes play an important part in speeding up transportation facilities and incidentally add to their reputation for efficiency in meeting emergencies. The work in process is open hearth steel forgings machined to specifications shown in the accompanying sketch. The "before and after" photos give a pretty good idea of the extent and completeness of the several operations, which include: 1st, chuck by stem and true off edge of flange; 2nd, chuck by flange and finish stem end—using tool mounted in turret and having three cutters. Then thread end of stem. 3rd, chuck once more by stem, face flange and chamfer.



The pieces are put through in lots—each operation carried out on a dozen or more parts before the set up is changed for the next—and when all are completed and the time figured, it averages 14 minutes for each piece — by no means spectacular but interesting. Have you a troublesome multi-operation job?



"Leave it to Libby"

INTERNATIONAL MACHINE TOOL CO.

Indianapolis, Ind., U. S. A.

DOMESTIC AGENTS: Bowman-Blackman Machine Tool Co., St. Louis, Mo. Brown & Zortman Machinery Co., Pittsburgh, Pa. Eccles & Smith Co., San Francisco, Cal., Los Angeles, Cal., Portland, Ore. E. L. Essley Machinery Co., Chicago, Ill., Milwaukee, Wis., and Moline, Ill. Strong, Carlisle & Hammond Co., Detroit, Mich., and Cleveland, Ohio. Vandyck-Churchill Co., New York, N. Y., New Haven, Conn., and Philadelphia, Pa. Syracuse Supply Co., Syracuse, N. Y., and Buffalo, N. Y. Aumen Machinery Co., Baltimore, Md. Northern Machinery Co., Minneapolis, Minn. FOREIGN AGENTS: Coats Machine Tool Co., Ltd., London, Eng. Iznoskoff & Co., Petrograd, Moscow and Ekaterinburg, Russia. Hijo De Miguel Mateu, Barcelona, Spain. Isbecque & Company, Belgium. Moerch & Roumet, Paris, France.



NEW BRITAIN

"Best Automatic Screw Machine On The Market"

A. WATKINS, Manager
THE ATLANTIC MFG. CO.
Bridgeport, Conn.

And his assertion is based on 25 years' experience in handling screw machines.



The operator is showing you some motor truck bolts just finished on the "New Britain." They are made from 7/8″ hex cold rolled stock, on which a 1/2″ body is turned for a length of 4⅜″ and threaded 1¼″ with 20 pitch threads.

Sixty bolts an hour are picked from the chip pan—accurate to within plus or minus 0.001″.

Is Mr. Watkins justifiably enthusiastic over "New Britain" production? What do *you* think?

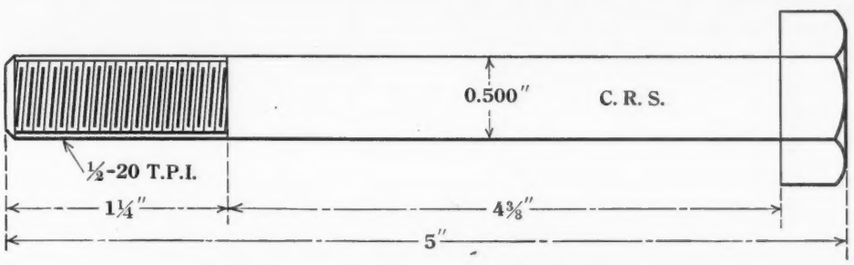
"NEW BRITAIN" NB NONE BETTER

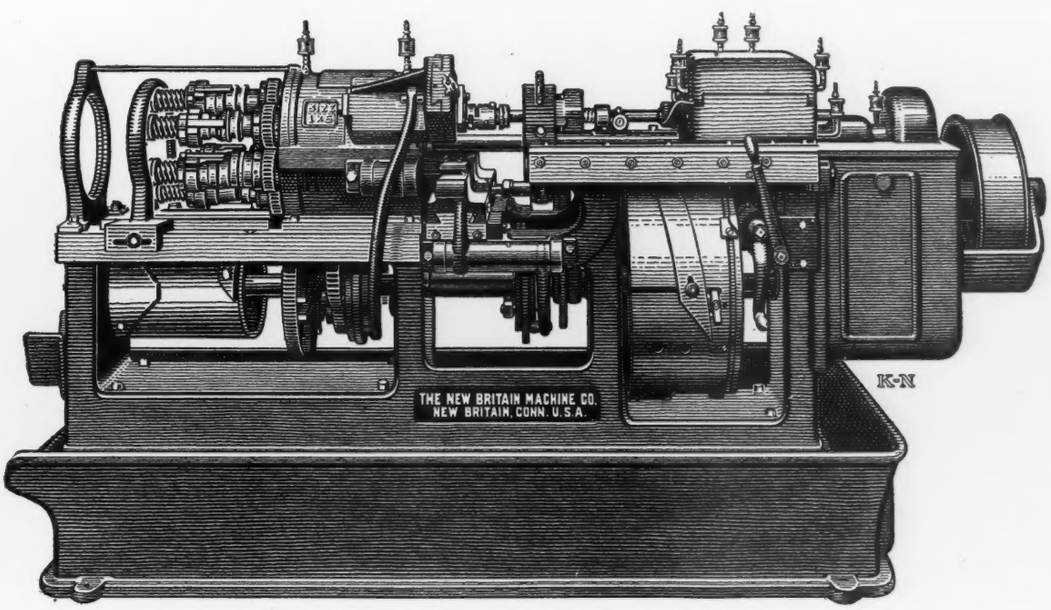
THE NEW BRITAIN

Automatic Chucking Machines

NEW BRITAIN,

AUTOMATICS





"New Britain" Automatics are turning out parts for tanks, automobiles, motorcycles, phonographs, fuses, typewriters and for other machines of war, commerce and amusement. For speedy work they have no superior.

Our engineer will be glad to call on you and show you what "New Britain" Automatics can do for you on such jobs. And he'll also come around after you buy *to see that they do it.*

Write us today for more details.

MACHINE COMPANY

CONNECTICUT

Automatic Screw Machines

"NEW BRITAIN" NB NONE BETTER

LEES-BRADNER
COLLET TYPE THREAD MILLERS



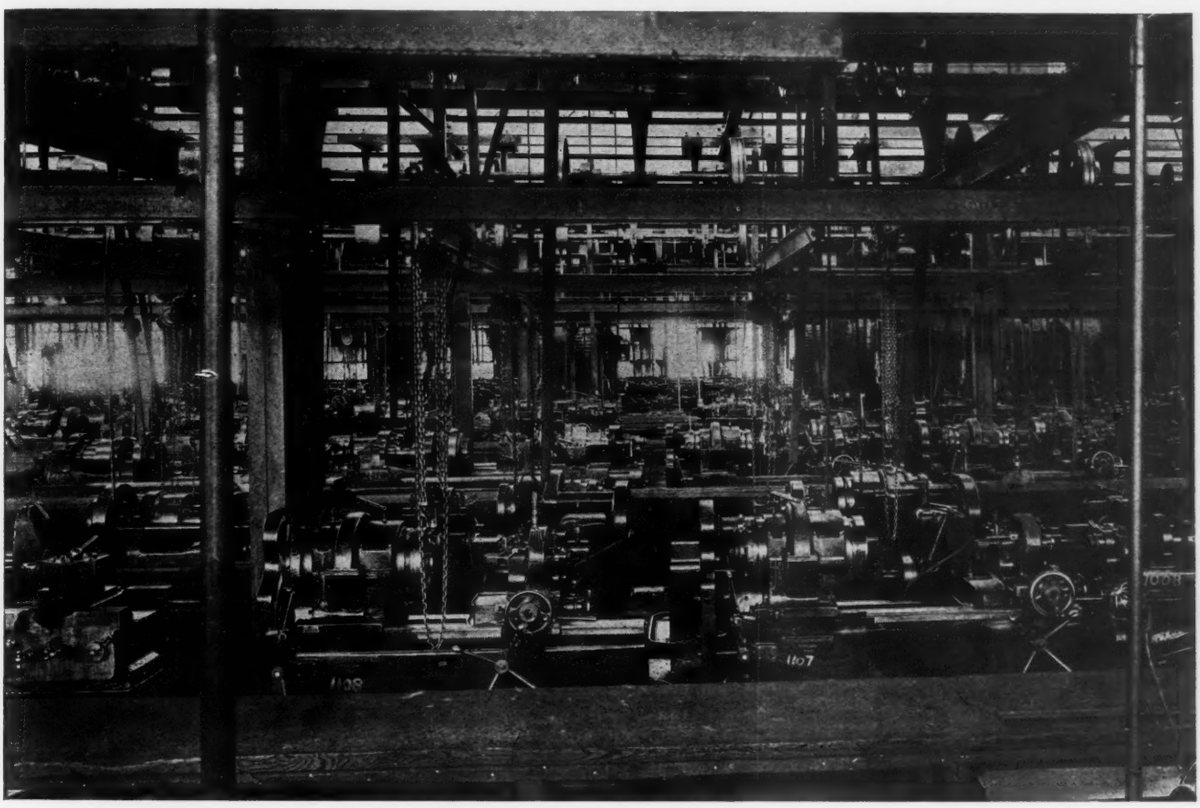
Part of the Total Installation of Lees-Bradner
The Accepted Standard For Munition Manu

THESE machines will cut a full thread up to a shoulder. In operation there is no reversal of rotating parts so that no time is lost on account of back lash. The lead screw is reversed once for about fifty pieces. These Collet type thread millers are adapted for milling internal or external

THE LEES-BRADNER COMPANY
CLEVELAND, U. S. A.

THREAD MILLERS GEAR GENERATORS

LEES-BRADNER
COLLET TYPE THREAD MILLERS



Collet Type Thread Millers in One Plant facturers; Approximately 1000 in Operation

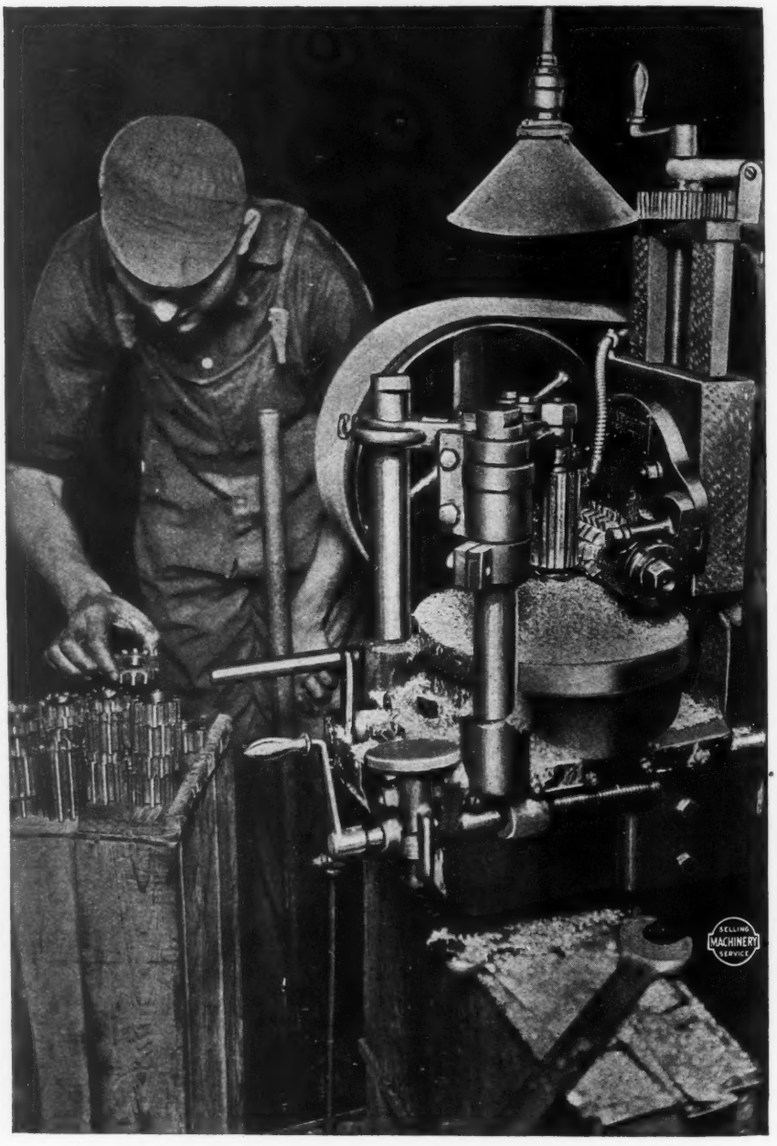
threads with a hob type cutter in one revolution of the work. The work is supported in a positive opening and closing Collet. Remarkable accuracy and production are obtained. Built in sizes up to 9½-inch Collet capacity. Send us blue prints of the work under consideration.

THE LEES-BRADNER COMPANY
CLEVELAND, U. S. A.

THREAD MILLERS GEAR GENERATORS

FARWELL

Farwell Gear Hobbers Boost Production Always



This Farwell Gear Hobber is one of three owned by the Pittsburgh Gage and Supply Company, Pittsburgh, Pa. One man handles all three machines—and has time for other work besides.

The pinions shown are for electric washing machines, and have 12 teeth, of 6 diametral pitch, ½-inch face. The material is 35 point carbon steel. Eight pinions are mounted on the arbor of the Farwell Hobber at one time. Without crowding the machine production is 200 finished pinions per nine hour day.

The foreman says, "The Farwells certainly are great machines for bringing up production. We do not push them and still they give us the work in very good time."

The ease and rapidity with which it may be set up for work or changed from one job to another is a feature which makes the Farwell highly esteemed at this plant.

If you have gears to cut let us show you the many advantages of Farwell methods.

THE ADAMS COMPANY, **1901 MARKET STREET DUBUQUE, IOWA, U.S.A.**

Immediate Deliveries

IT is not very patriotic—and is no longer necessary—to tie up a tool-shop with the making of snap gages. Tool-makers' time is too valuable in these days to be used up in *making* what can better be *manufactured.*

Our stock of JOHANSSON Adjustable Limit Snap Gages has not been so complete in months. WE ARE NOW MAKING IMMEDIATE DELIVERIES.

There is, of course, no guarantee that this condition will continue. But "immediate delivery" is the order for the present, and our many customers will be interested to learn of it.

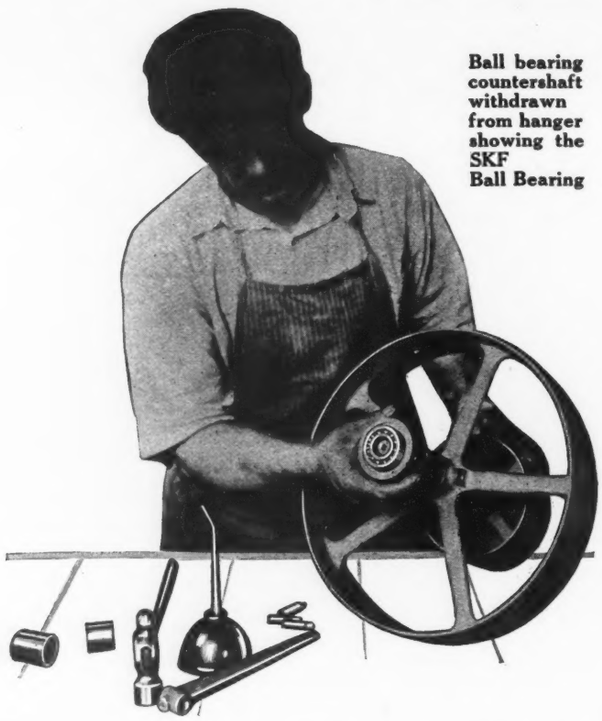
Johansson

Adjustable
Limit Snap Gages



Capacity from 0 in. to 12 in.

THE SWEDISH GAGE COMPANY, Inc.
245 West 55th Street, New York
Canadian Branch, 10 Cathcart St., Montreal



Ball bearing countershaft withdrawn from hanger showing the SKF Ball Bearing

Ball Bearing Countershafts

Countershafts equipped with SKF Self-Aligning Ball Bearings have the distinct advantage of requiring very little attention and operating with the least loss of power. They can be run at high speed and heavy load without any danger from heated bearings. Oil tight housings prevent the leakage of lubricant, and the high speed at which they may be operated permits the use of narrower and lighter belts.

SKF BALL BEARING CO.

HARTFORD 445 CONNECTICUT

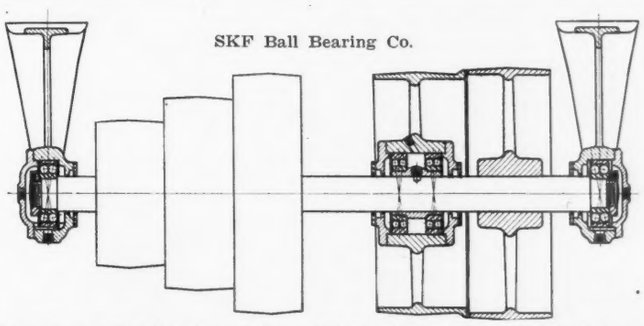


SKF

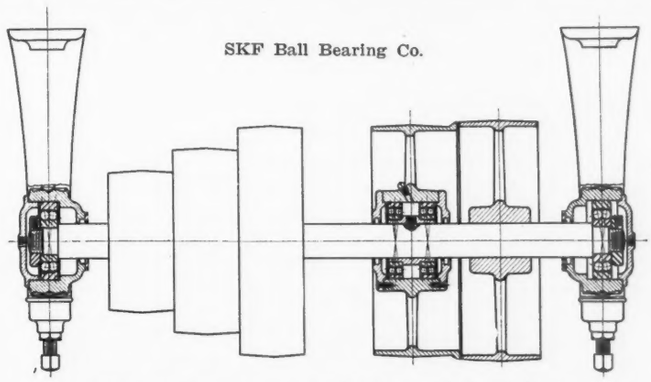
No. 3 of a Series of Recommendations from the SKF Engineering Service Department to Machinery Designers and Builders

COUNTERSHAFTS

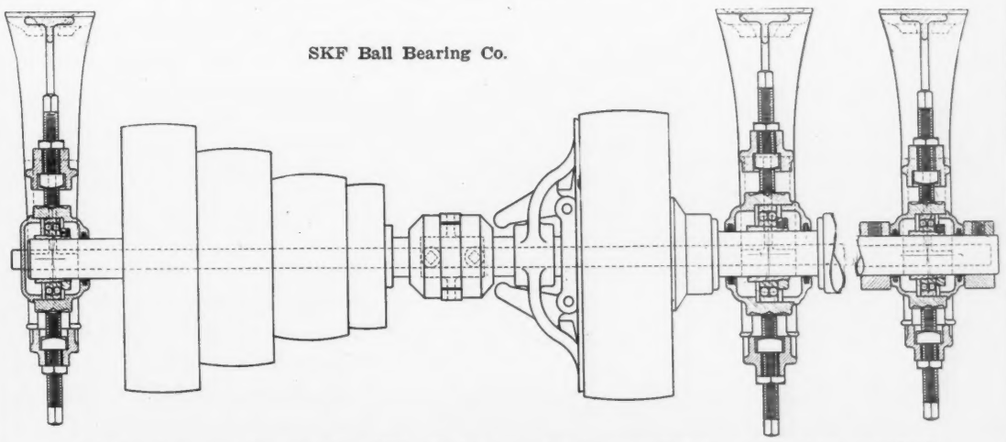
This series of suggestions started in the June issue of MACHINERY. Other mounting suggestions will follow. We shall be glad to furnish reprints if desired.



Rigid type hanger and standard type SKF radial bearings. The aligning feature of the SKF bearing allows the use of rigid hangers. No other bearing will give satisfaction when used with rigid type hangers.



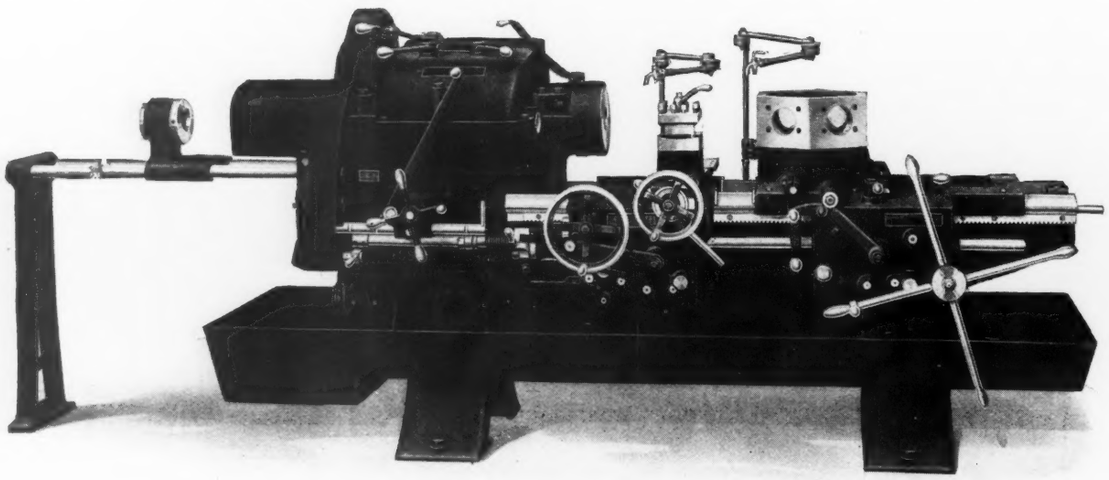
Adjustable type hanger and standard type SKF radial bearings.



Ball Bearing mounting showing SKF adapter type bearings applied to countershaft, standard type adjustable hanger casings.

THESE ARE

Foster 2-B Universal Turret Lathe



Foster 2-B Universal Turret Lathe with Automatic Chuck and Bar Feed

THE FOSTER LINE

No. 1-B UNIVERSAL TURRET LATHE
Bar Cap. 2″ Swing over Carriage, 14″ over Cross Slide, 8″

No. 2-B UNIVERSAL TURRET LATHE
Bar Cap. 3¼″ Swing over Carriage, 20″ over Cross Slide, 13½″

No. 0 PLAIN HEAD SCREW MACHINE
Bar Cap. 9/16″ 10″ Swing

No. 1 PLAIN HEAD SCREW MACHINE
Bar Cap. 13/16″ 11″ Swing

No. 2 PLAIN AND FRICTION HEAD SCREW MACHINES
Bar Cap. 1 1/16″ 13″ Swing

No. 3 PLAIN, FRICTION AND ALL GEARED HEAD SCREW MACHINES
Bar Cap. 1 5/16″ 14″ Swing

No. 4 FRICTION HEAD SCREW MACHINE
Bar Cap. 1 9/16″ 17¼″ Swing

No. 5 ALL GEARED HEAD SCREW MACHINE
Bar Cap. 1 13/16″ 17¼″ Swing

Nos. 6, 7, 8, 9, 10 FRICTION HEAD SCREW MACHINES
Bar Cap. 2 1/16″; 2 5/16″; 2 9/16″; 2 13/16″; 3 1/16″, respectively 20″ Swing

No. 2 FRICTION HEAD UNIVERSAL TURRET LATHE
Bar Cap. 1 5/16″ 14″ Swing

No. 2 FRICTION SET-OVER TURRET LATHE
Bar Cap. 1 5/16″ 14″ Swing

No. 3 FRICTION HEAD UNIVERSAL TURRET LATHE
Bar Cap. 1 9/16″ 16″ Swing

No. 3 FRICTION HEAD SET-OVER TURRET LATHE
Bar Cap. 1 9/16″ 16″ Swing

Thread Millers manufactured under the Holden-Morgan patents

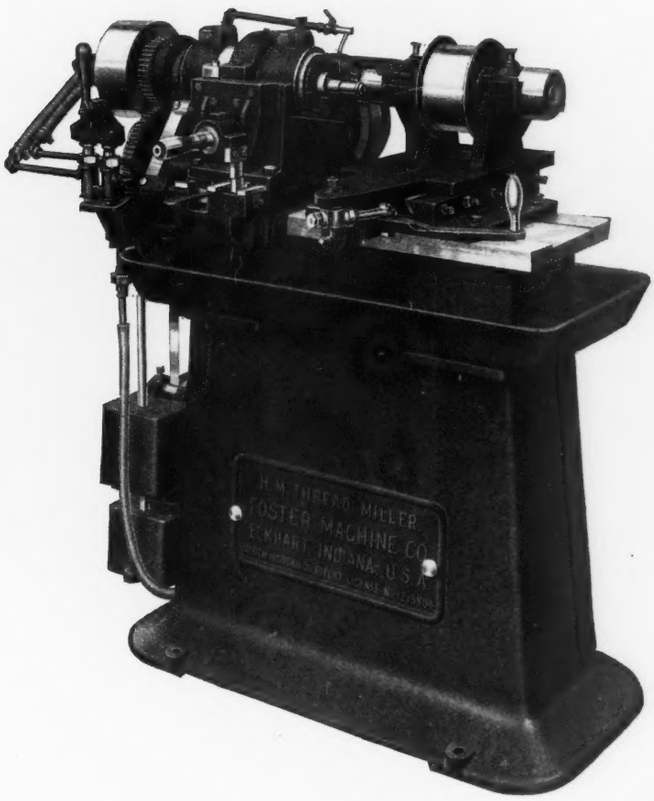
With our 2-B Universal Turret Lathe now ready for delivery, we have one of the most complete lines of screw machines and turret lathes upon the market. The general construction of the 2-B is the same as that of our famous 1-B Universal Turret Lathe, but is of a much heavier construction. It has a bar capacity of 3¼″ and a chucking capacity of 13½″ over the cross slide. This machine is also equipped with a full line of tools and attachments. It may be arranged for motor drive, if desired, or a special countershaft can be furnished at an additional charge.

Our Engineering Department is at your service and if you will mail us blue prints of your production problems we will be glad to furnish you all necessary information free.

FOSTER MACHINE COMPANY,

PRODUCERS

H. & M. Thread Miller



The H. & M. Thread Miller is now being manufactured by us under the Holden and Morgan Patent License No. 125804. This machine has won a reputation for itself in the ammunition plants of the foreign countries and has universally been adopted by the American Engineers as the quickest and most accurate method of producing threads in all metals at this time. The H. & M. Thread Miller is as accurate as a micrometer. This machine has no lead screw where there might be a possible chance for error and back lash, but the master thread is cut directly on the main spindle and is engaged by a bronze block which is fastened securely to the head casting. The complete thread is cut on the piece with slightly over one revolution of the spindle. The extremely short overhang of the spindle and the large shaft carrying the cutter entirely eliminates all chatter and allows a high rate of production to be obtained.

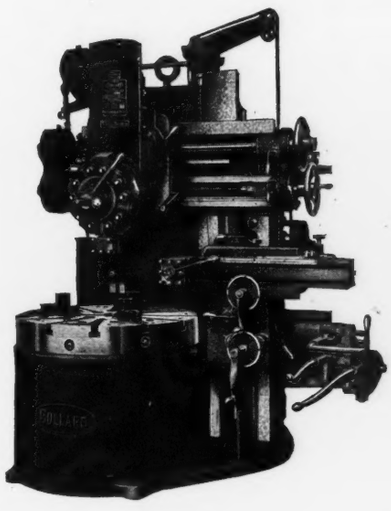
The standard equipment calls for an air operated chuck, but this may be substituted by a mechanically operated chuck. These machines are adapted to all styles of ammunition work from the smallest to the largest projectiles.

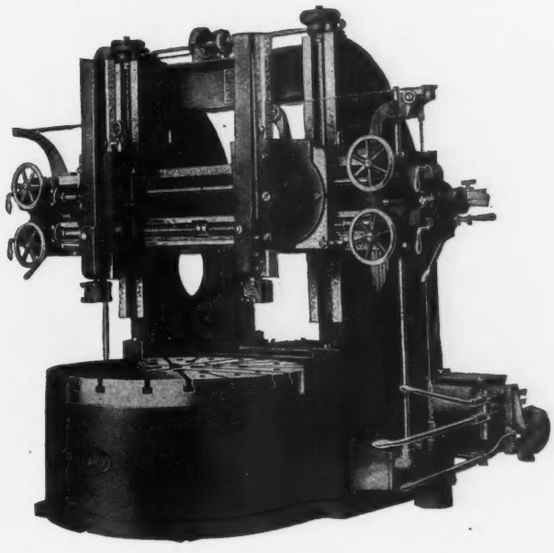
Write today and send us blue prints of your threading problems and let our Engineering Department solve them for you.

ELKHART, INDIANA, U. S. A.


BULLARD
FORGE DEPARTMENT
THE BULLARD
FORGE SHOP
BULLARD
THE BULLARD
MACHINE SHOP
THE BULLARD
FOUNDRY

"In the Nation's Service"





The Bullard Organization, as well as its product, is truly "In the Nation's Service."

The Main Plant has been more than doubled in productive capacity as a result of new buildings, new equipment and an unequaled *esprit de corps.*

A new Foundry and a new Forge Shop, completed within the year, are proving to be big factors in meeting the demand for Bullard product—they insure a prompt and continuous supply of castings and forgings of the quality required for Bullard Tools.

BULLARD

VERTICAL TURRET LATHES

24-Inch 36-Inch 42-Inch

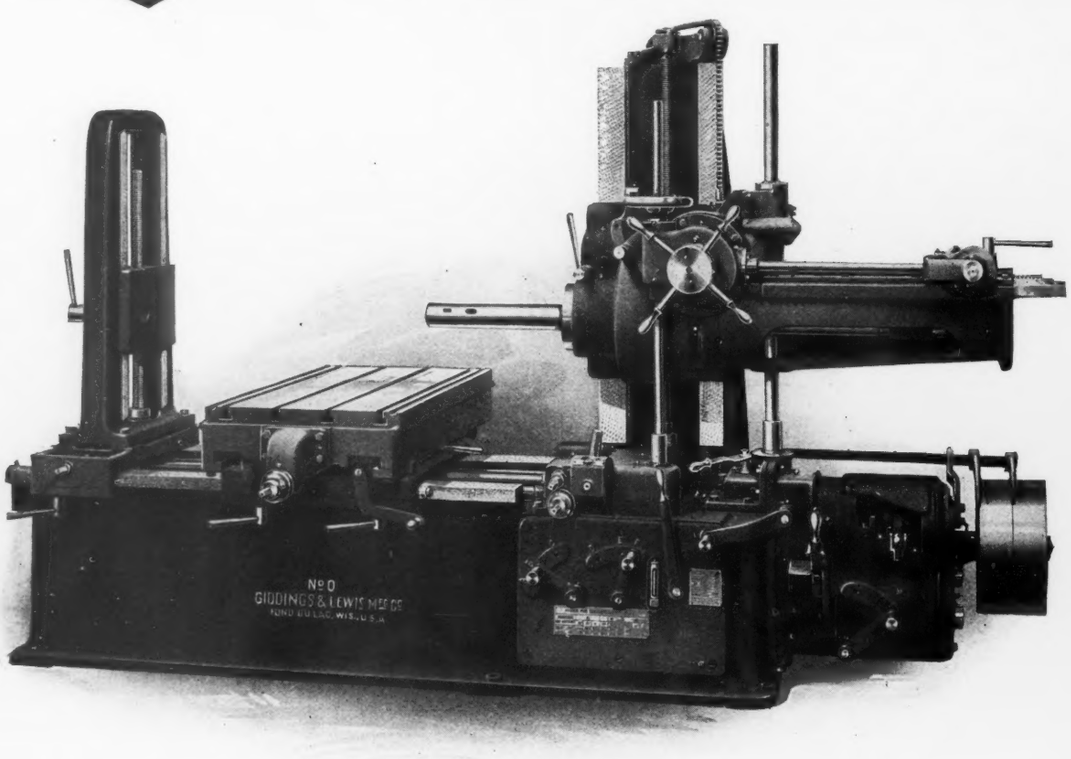
and 61-Inch MAXI-MILLS

are in line for early delivery

The Bullard Machine Tool Company

BRIDGEPORT **CONNECTICUT, U. S. A.**

Horizontal Boring, Drilling and Milling Machines



INCORPORATING many exclusive features and brought down to date by experienced engineers, G. & L. Precision Horizontal Boring, Drilling and Milling Machines undoubtedly offer the greatest efficiency in machine tools of this class.

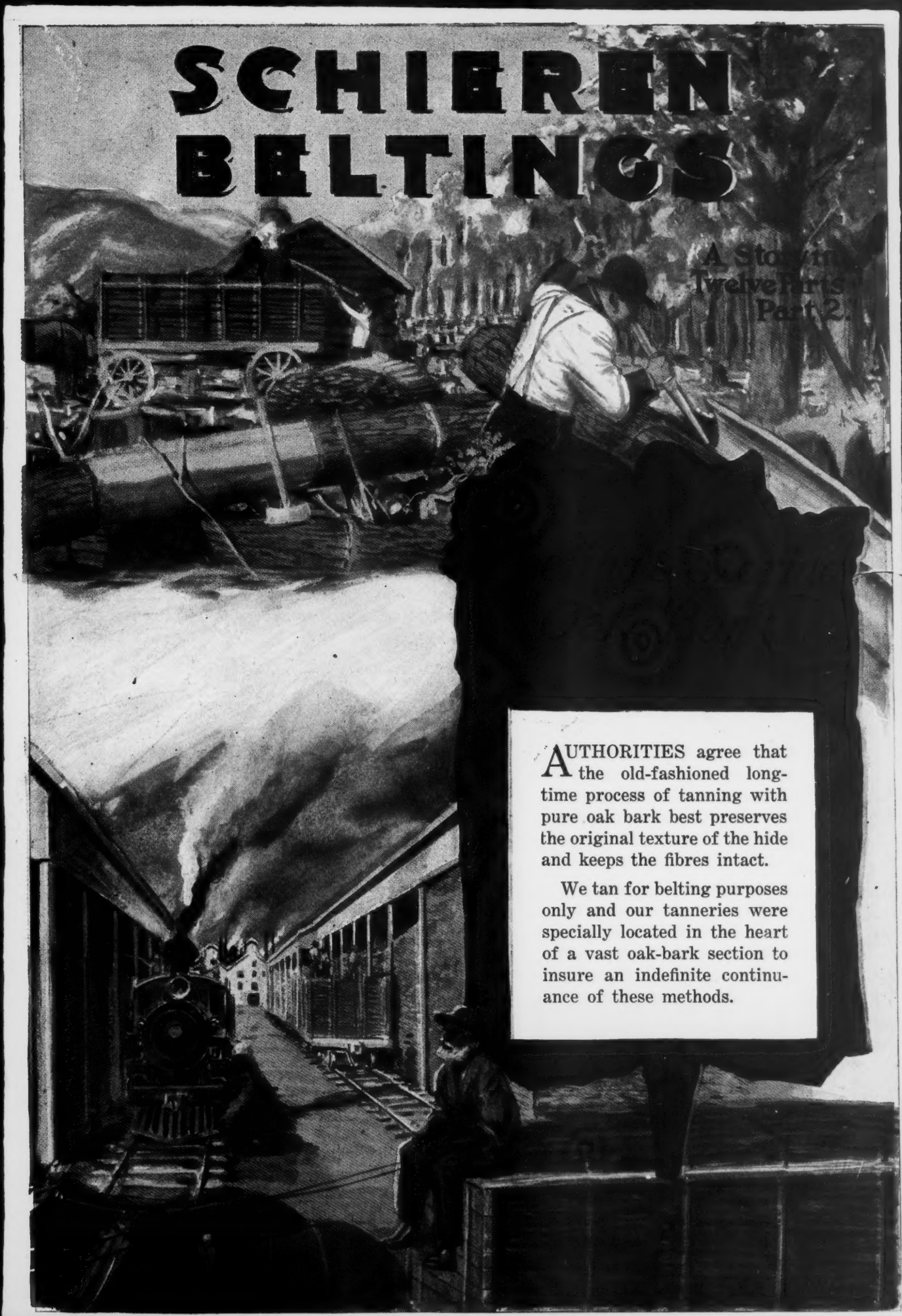
The photograph shows No. 0, the smallest of a complete line. Specifications sent upon request.

GIDDINGS & LEWIS MANUFACTURING COMPANY

FOND DU LAC **WISCONSIN, U. S. A.**

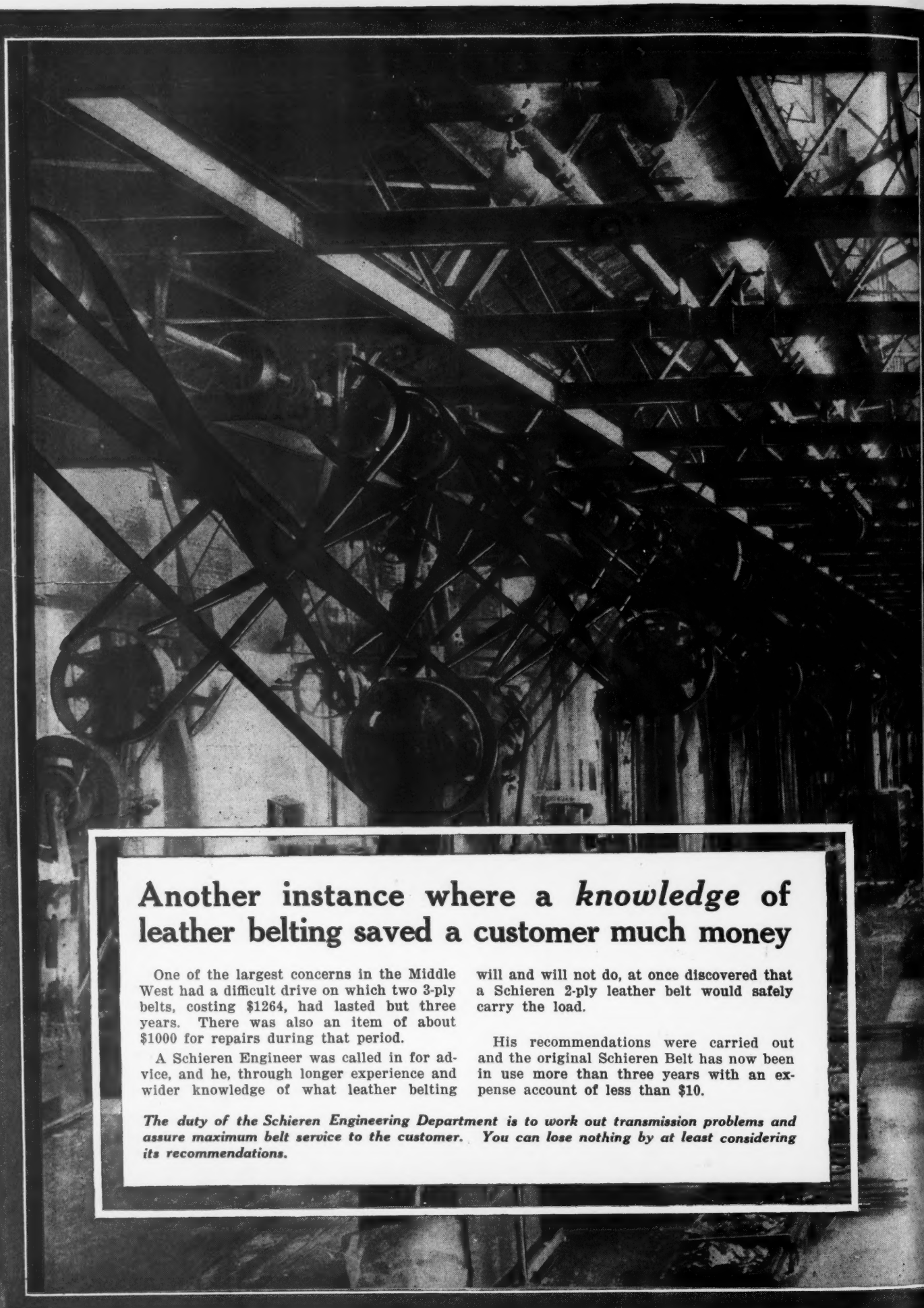
DOMESTIC AGENTS: Taylor Machinery Co., Boston; Fairbanks Co., New York, Albany, New Orleans, Hartford, H. A. Smith Machinery Co., Syracuse; Swind Machinery Co., Philadelphia; Sherritt & Stoer Co. (Virginia Territory), Philadelphia; Somers, Fitler & Todd Co., Pittsburgh; E. A. Kinsey Co., Cincinnati, Indianapolis; Motch & Merryweather Mchy. Co., Cleveland, Detroit; Bowman-Blackman Mch. Tool Co., St. Louis; Stocker-Rumley-Wachs Co., Chicago, Milwaukee; English Tool & Supply Co., Kansas City; Sunderland Machinery & Supply Co., Omaha; Hendrie & Bolthoff Mfg. & Supply Co., Denver; Salt Lake Hdwe. Co., Salt Lake City; Eccles & Smith Co., San Francisco, Los Angeles, Portland.

FOREIGN AGENTS: Canadian Fairbanks Morse Co., Canada; Fenwick Freres & Co., France, Italy, Belgium, Switzerland, Spain, Portugal; Burton, Griffiths & Co., England; Rylander & Asplund, Sweden; Wymalen & Hausmann, Holland; R. L. Scrutton & Co., Ltd., Australia.



AUTHORITIES agree that the old-fashioned long-time process of tanning with pure oak bark best preserves the original texture of the hide and keeps the fibres intact.

We tan for belting purposes only and our tanneries were specially located in the heart of a vast oak-bark section to insure an indefinite continuance of these methods.



Another instance where a *knowledge* of leather belting saved a customer much money

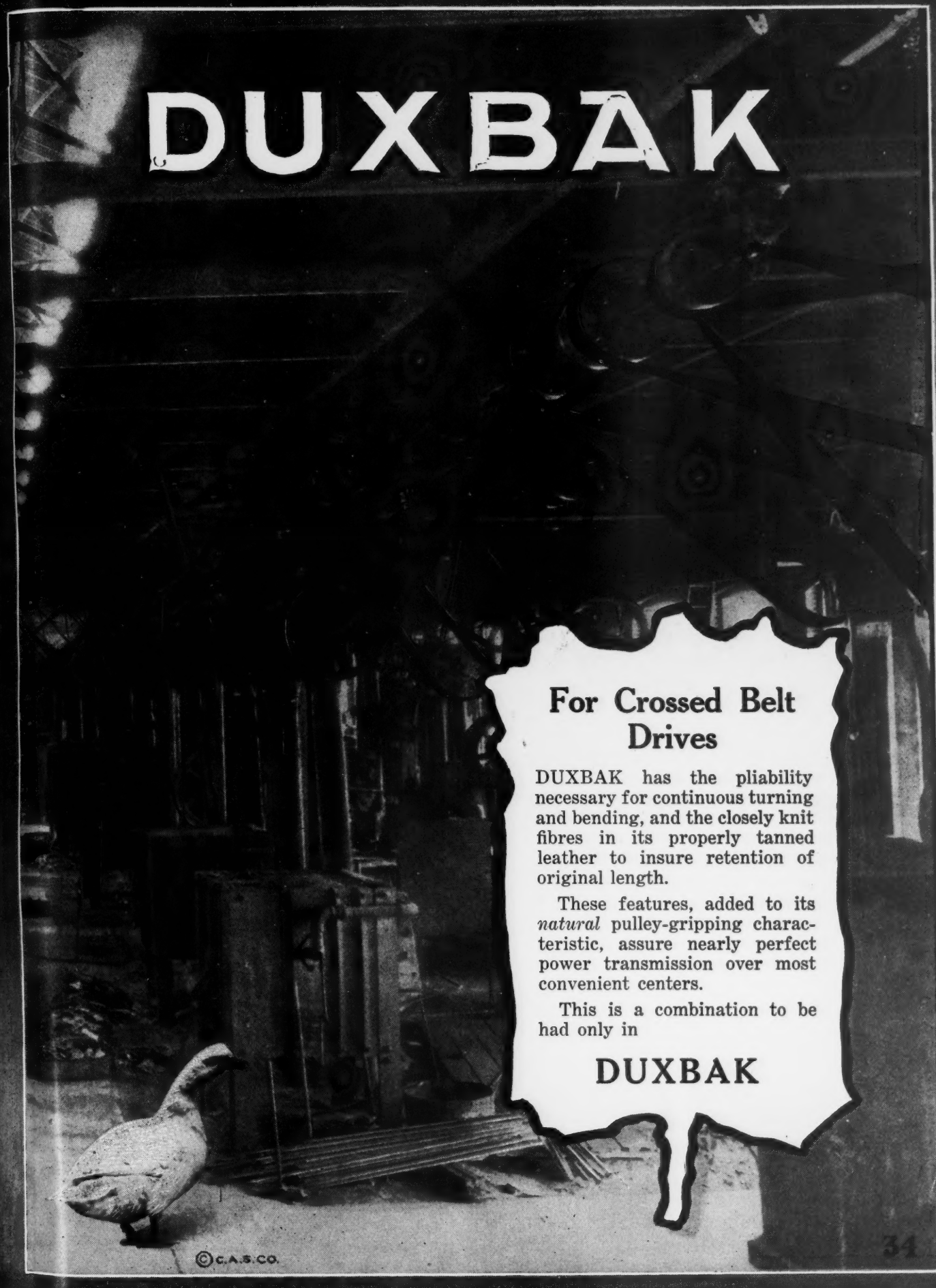
One of the largest concerns in the Middle West had a difficult drive on which two 3-ply belts, costing $1264, had lasted but three years. There was also an item of about $1000 for repairs during that period.

A Schieren Engineer was called in for advice, and he, through longer experience and wider knowledge of what leather belting will and will not do, at once discovered that a Schieren 2-ply leather belt would safely carry the load.

His recommendations were carried out and the original Schieren Belt has now been in use more than three years with an expense account of less than $10.

The duty of the Schieren Engineering Department is to work out transmission problems and assure maximum belt service to the customer. You can lose nothing by at least considering its recommendations.

DUXBAK



For Crossed Belt Drives

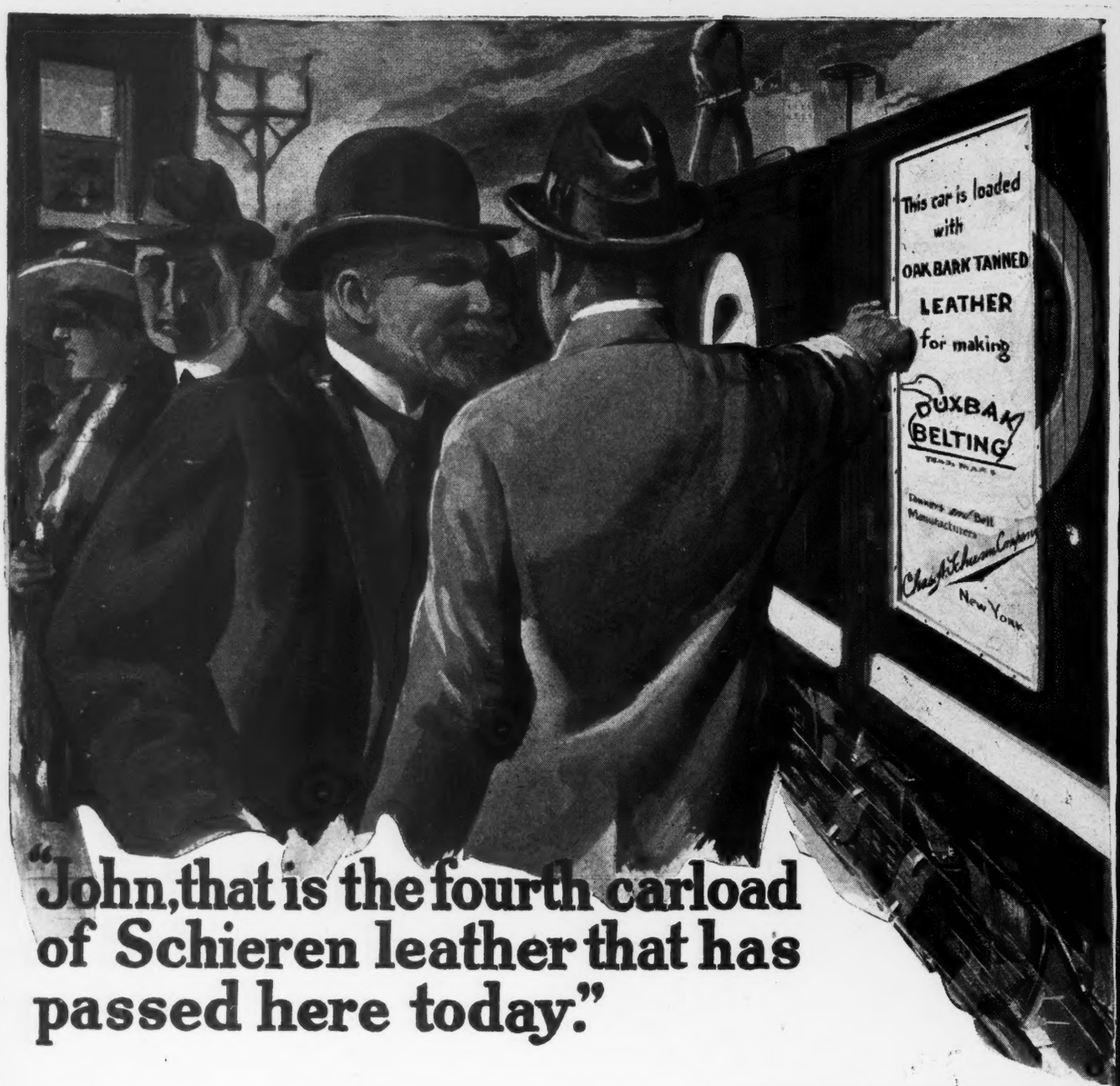
DUXBAK has the pliability necessary for continuous turning and bending, and the closely knit fibres in its properly tanned leather to insure retention of original length.

These features, added to its *natural* pulley-gripping characteristic, assure nearly perfect power transmission over most convenient centers.

This is a combination to be had only in

DUXBAK

©C.A.S.CO.



"John, that is the fourth carload of Schieren leather that has passed here today."

"Well, Harry, how does that interest you?"

"In this way, John. It can mean but one thing—that there is an enormous demand for DUXBAK Leather Belting.

"We have used nothing but DUXBAK for years for all drives where there is any chance of moisture, and it surely has paid us.

"Now it looks as though others were getting wise to the same fact, and also to the fact that DUXBAK is a darned good belting to use even where there is no moisture on account of its great pulling power."

"Harry, those are facts worth remembering. To tell the truth, I don't know what kind of belting we use, but I am going to look into the matter and have a say as to what kind we buy hereafter."

DUXBAK BELTING
TRADE MARK
Reg. U.S. Pat. Off.

Chas. A. Schieren Company

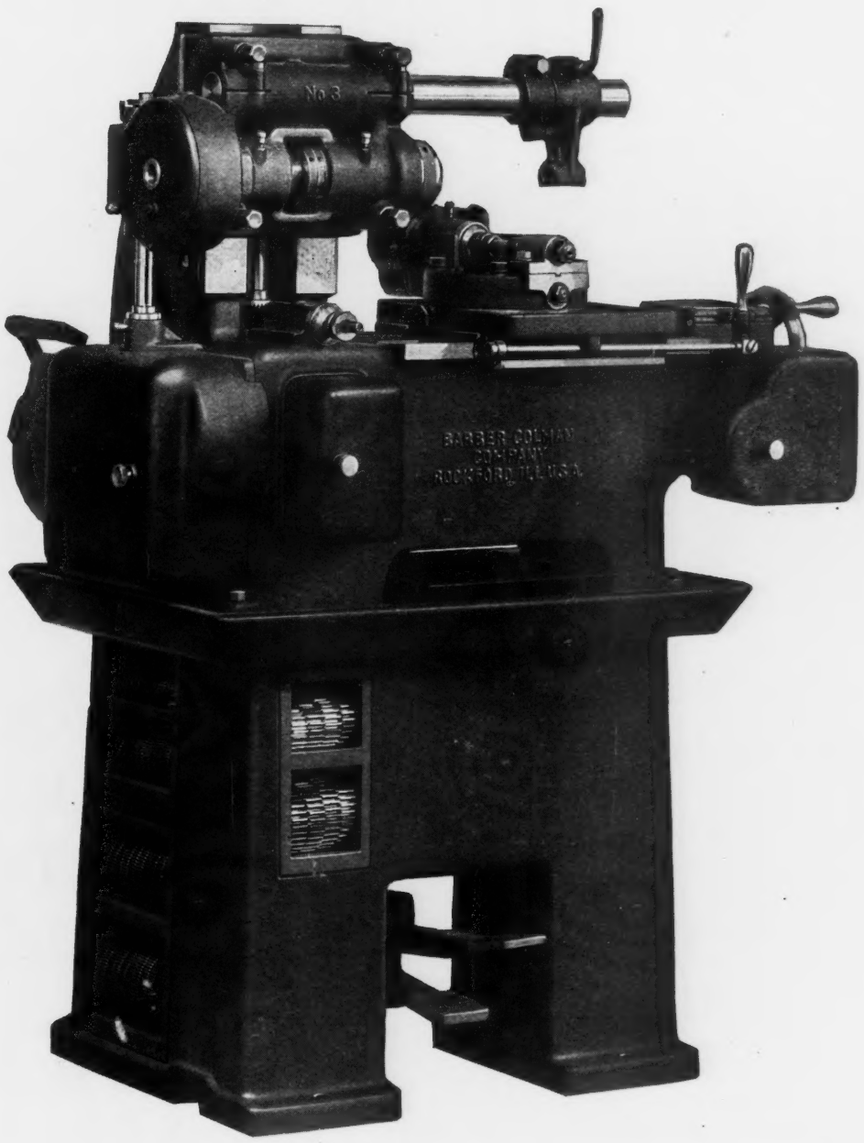
Tanners
Belt Manufacturers
73 Ferry Street, New York

Atlanta, Ga.	190 Marietta St.
Boston	232 Summer St.
Chicago	128 West Kinzie St.
Cleveland	777 Rockwell Ave.
Dallas, Tex.	The Texas Chas. A. Schieren Co., Inc., Murray & Williams Sts.
Denver	1752 Arapahoe St.
Detroit	72 Congress St., West
Kansas City	1324 West 12th St.
Memphis, Tenn.	475 So. Main St.
Philadelphia	226 North Third St.
Pittsburgh	337 2nd Ave.
Salt Lake City	Dooly Bldg.
San Francisco	257 Mission St.
Seattle	305 First Ave., South
St. Louis	507 Pontiac Bldg.
Oak Leather Tanneries, Bristol, Tenn.	



BARBER-COLMAN

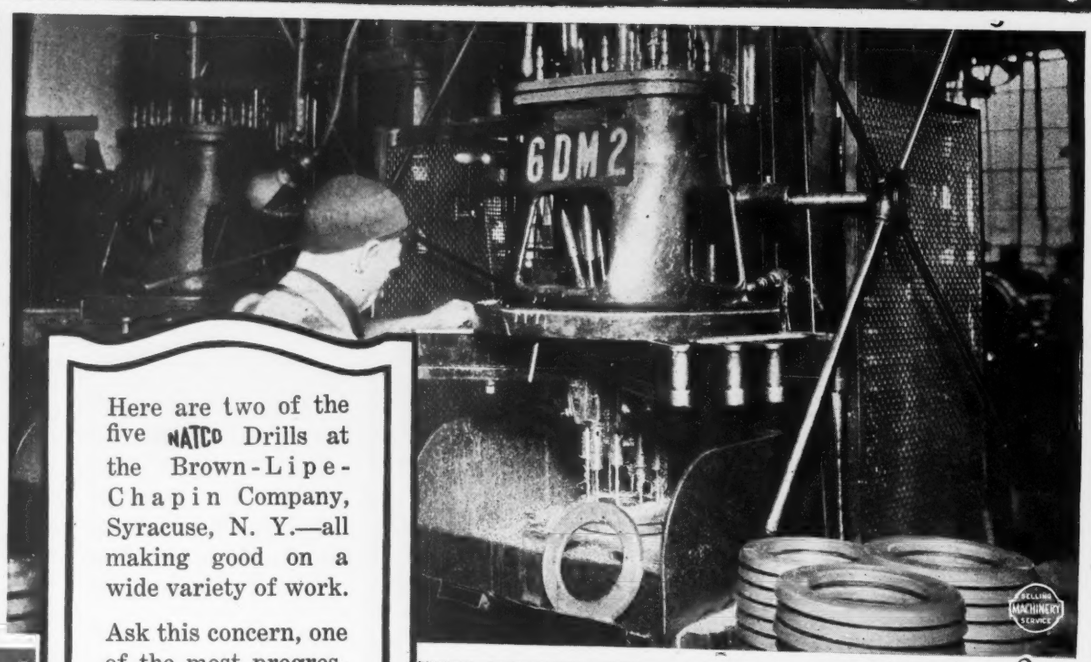
No. 3 Gear Hobbing Machine



The hobbing process is the modern, accurate, economical way to cut gears. Rapidity is assured by the continuous cutting action of the hob. Accuracy can be held within closest limits. Our No. 3 machine is designed for spur and spiral gears—ratchets, sprockets and similar forms—and with our vertical feed attachment, worm gears can also be hobbed. Ask us how much this machine can increase your production. Catalog on request.

BARBER-COLMAN COMPANY

ROCKFORD, ILL., U. S. A.



Here are two of the five NATCO Drills at the Brown-Lipe-Chapin Company, Syracuse, N. Y.—all making good on a wide variety of work.

Ask this concern, one of the most progressive in the country, about NATCO machines.

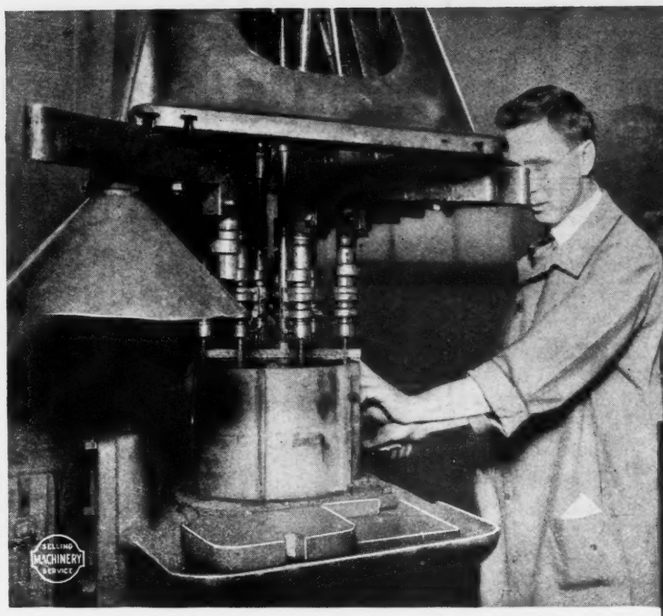
"There's a Drill Speed for Every Need"



WHEREVER THERE ARE MANY HOLES TO DRILL

NATCO

DRILLS ARE USED



This NATCO is owned by the Metric Meter Works, Erie, Pa., and is used for both tapping and drilling.

And here we see a NATCO drilling Hup Motor Car cylinder covers. One operator keeps two of these machines going.

"There's a Drill Speed for Every Need"

NATCO

MULTIPLE DRILLS

The NATCO Multiple Drill has patented independent spindle speeds—every tool gets its correct speed and feed. The machine is a wonderful producer. Types and sizes for all purposes. Let us show you.

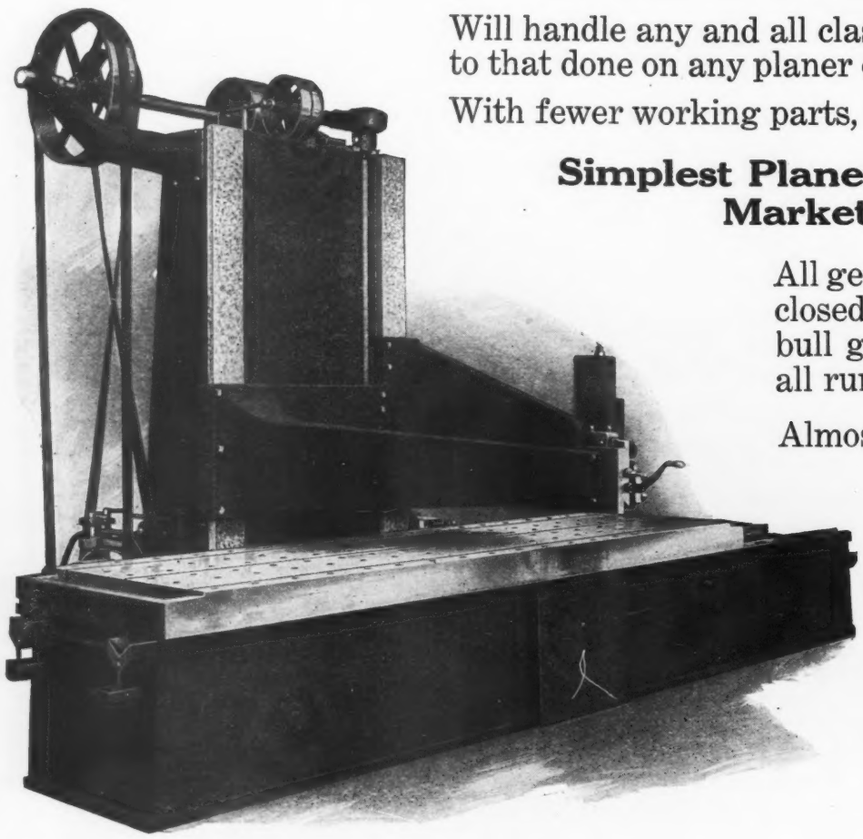


THE NATIONAL AUTOMATIC TOOL COMPANY

RICHMOND, INDIANA, U. S. A.

Rigid and Accurate

The "Cleveland" Open Side Planers



Will handle any and all classes of work equal to that done on any planer of any type.

With fewer working parts, it is the

Simplest Planer on the Market

All gears in drive are enclosed, and except the bull gear and its pinion all run in oil.

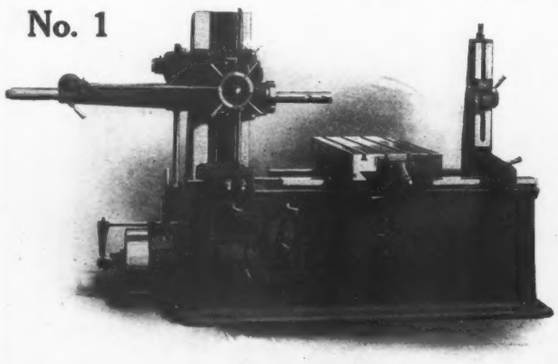
Almost fool-proof.

May we send you a catalog?

The Cleveland Planer Company

3152 Superior Ave., CLEVELAND, OHIO, U. S. A.

No. 1



The Cleveland Horizontal Boring, Milling and Drilling Machine

is a rapid tool room machine of the most improved type. Simplicity of design and ease of operation are outstanding features; 12 changes of speed, and 16 changes of feed, can be made while the machine is in motion and control is by a single lever. The spindle head and outer support of this high grade machine are positively aligned by means of scales and verniers graduated to .001.

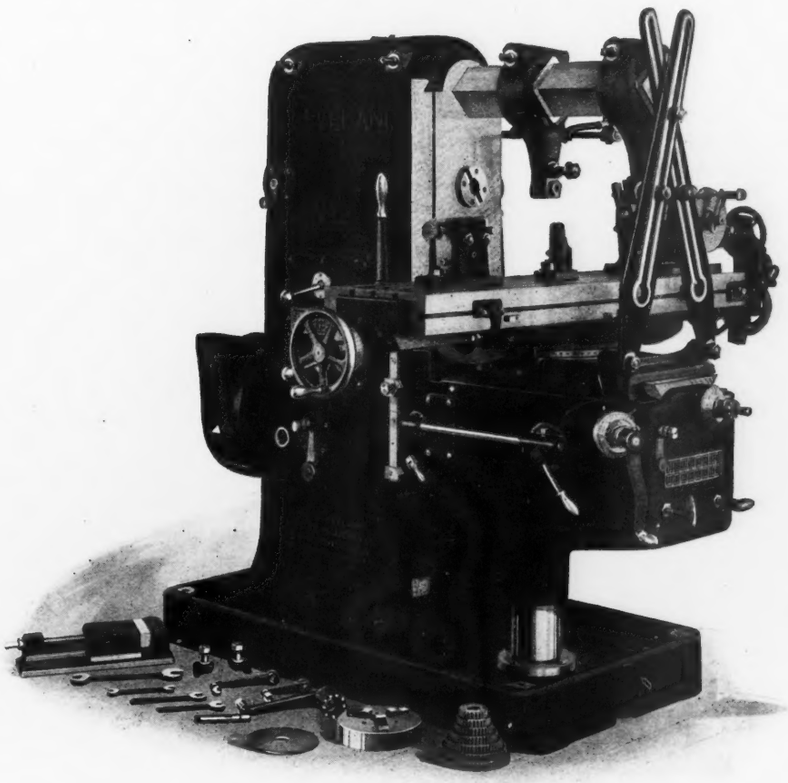
Circular?

The Cleveland Machine Tool Co.

CLEVELAND OHIO, U. S. A.

The Cleveland Milling Machine Co.

Milling Machine



Square over-arm.

Constant speed or single pulley drive.

Sixteen changes of speed.

Sixteen changes of feed.

All sliding gears, no tumbler gears.

All gears and shafts hardened and ground.

Feed box in knee.

All operating levers within easy reach of operator.

Bronze bearings throughout.

One piece elevating screw for knee.

No universal joint for feed drive.

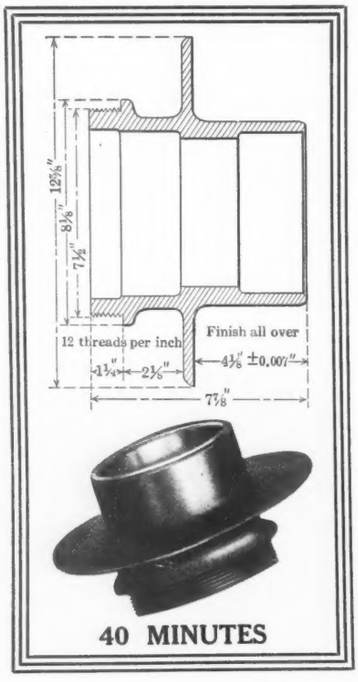
Column and knee automatically lubricated.

THE CLEVELAND MILLING MACHINE COMPANY

CLEVELAND, OHIO, U.S.A.

NEW YORK OFFICE: 1760-2 Woolworth Building

Milling Cutters Milling Machines Relieving Machines



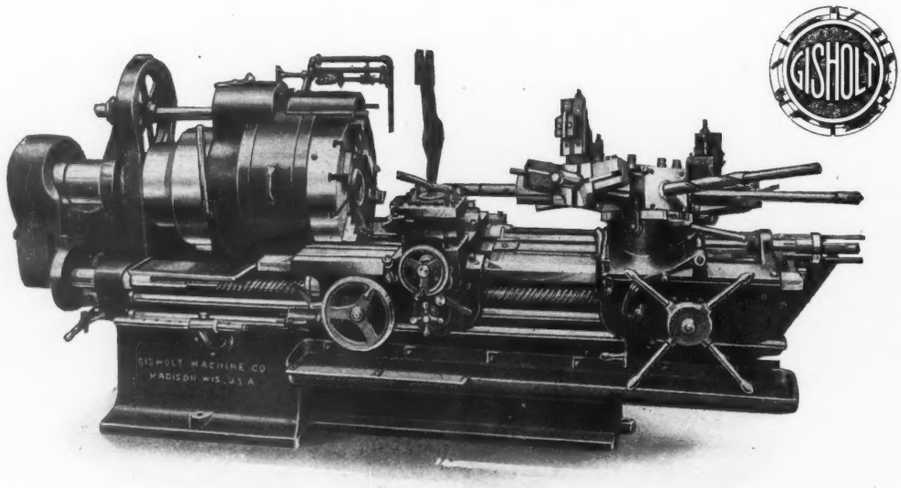
GISHOLT Turret Lathes

Another Gisholt Hub Job Forty Minutes

Standard Tools Lower Costs

Standard tools lower costs not only because they cost less, but because of the time they save. When a job like the above, for instance, can be produced with standard chucking tools, you will see the advantage.

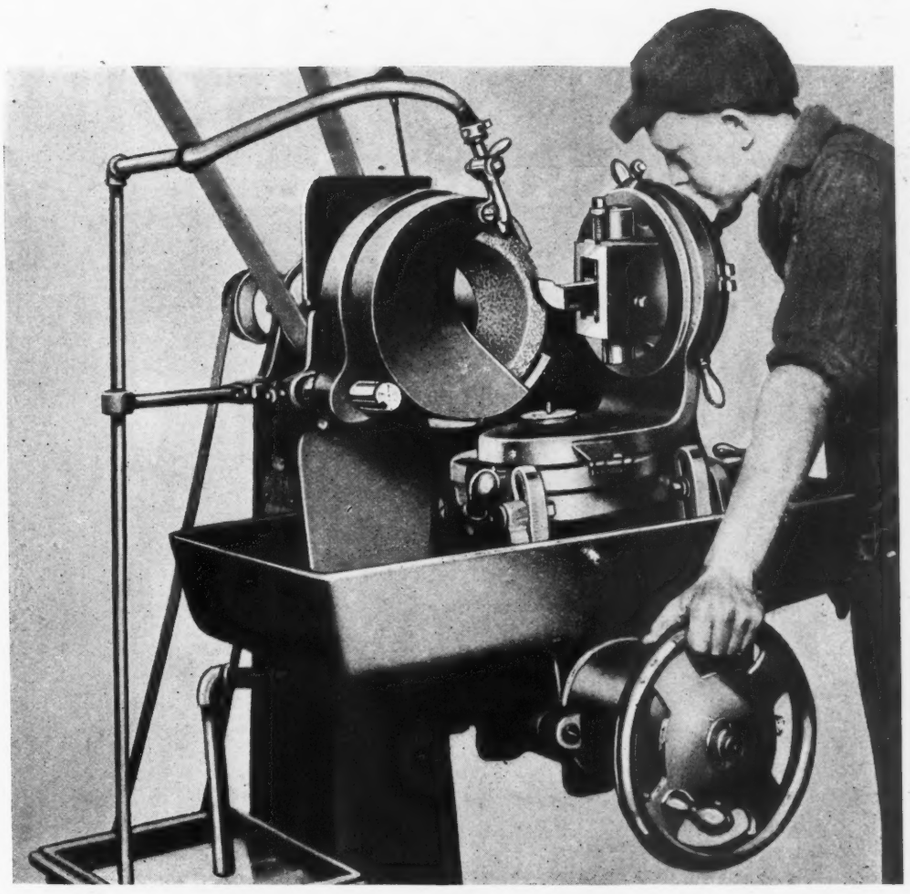
Have you any work that is similar? Compare our production time with yours.



GISHOLT MACHINE CO.,

Eastern Sales Office: 30 Church St., New York.

1200 E. WASH



GISHOLT

The More Varied the Tools The More Profitable is the

GISHOLT TOOL GRINDER

GISHOLT

The greater the variety of tools and number of angles to grind the more apparent are the speed and accuracy of the Gisholt Tool Grinder. A boy can grind more tools with this grinder, and with less effort, than a skilled mechanic can grind by hand. He will duplicate angles perfectly. He'll jump from one tool to the next without waste effort or loss of time.

Ask for the complete Grinder story.

Madison, Wisconsin, U. S. A.

INGTON AVENUE

Works: Madison, Wis., Warren, Pa.

Barber-Colman

Interlocking Cutters

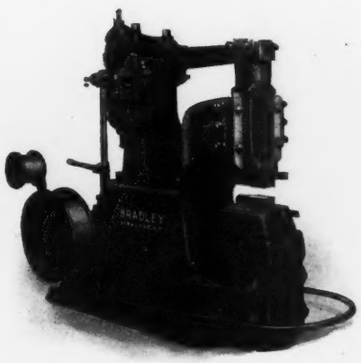


Standard, Form and Special Milling Cutters. Spur, Spiral and Worm-Gear Hobs.

Tools of Closest Accuracy

BARBER-COLMAN COMPANY

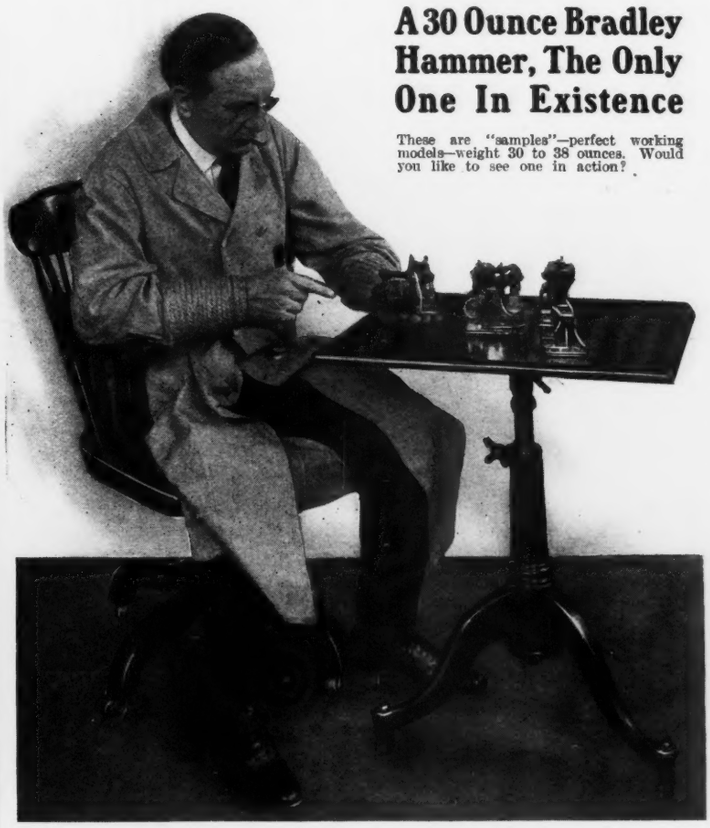
ROCKFORD, ILLINOIS, U. S. A.



Bradley Hammers

Weight From 800 to 13,200 Pounds Each

THE variety of forging and hammering operations which may be profitably performed on Bradley Hammers is amazing—we frequently find them doing things we never dreamed of. Also, the quantity of work being produced by Bradley Hammers is remarkable—there are more of these hammers in use to-day than all other makes of belt driven hammers combined. And as for the quality of Bradley forgings, you can rest assured that Bradley Hammers are there—if they were not you wouldn't find them in the big plants everywhere.



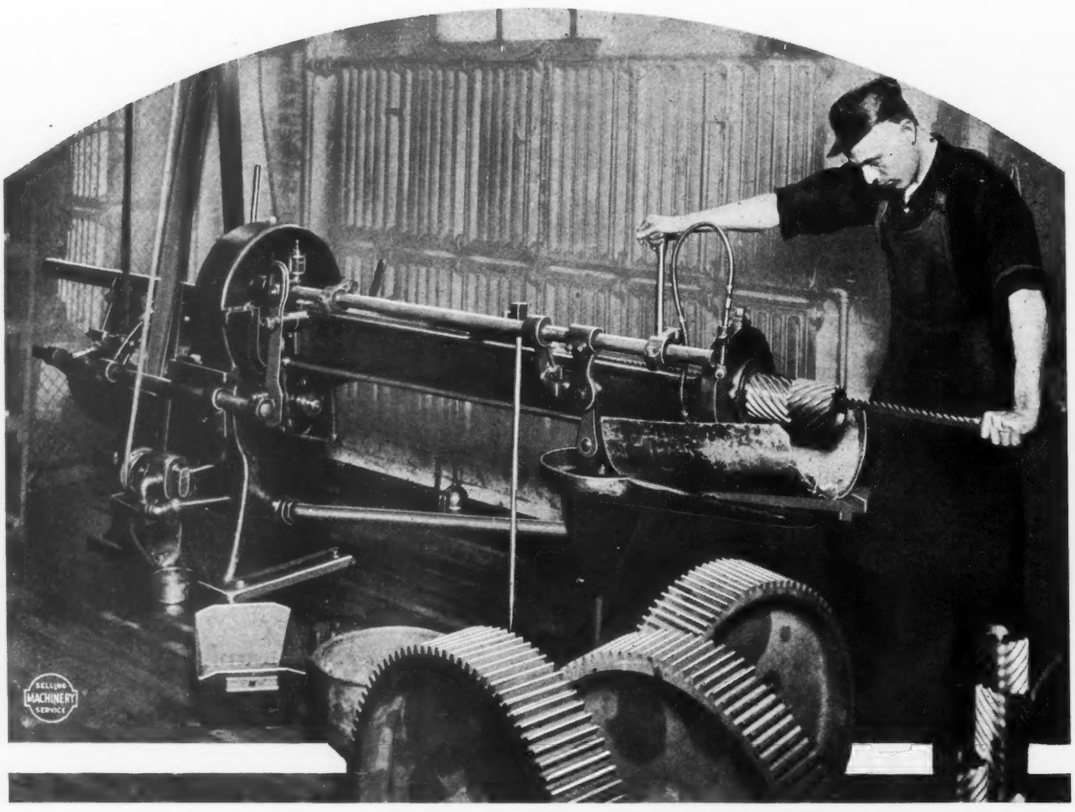
A 30 Ounce Bradley Hammer, The Only One In Existence

These are "samples"—perfect working models—weight 30 to 38 ounces. Would you like to see one in action?

Many are the reasons for Bradley popularity — range, convenience, adaptability and economy being among the more important. They are one-man machines with simple, conveniently located and responsive controls which permit a close degree of accuracy. They are durable hammers—built to stand hard, constant use. Let us send complete specifications.

C. C. BRADLEY & SON, Inc.
SYRACUSE, N. Y.

FOREIGN AGENTS: Brazil, France, Belgium, Switzerland, Spain and Portugal; Fenwick Freres & Co., 8 Rue de Rocroy, Paris. Italy, Taddeo, Giusti, Modena, Italy. England, Buck & Hickman, Ltd., London.



J. N. Lapointe Co. Broaching Equipment
is the Answer to Keyseating Problems

For Instance: The J. N. Lapointe Co. Broaching Machine shown in the accompanying photograph is broaching 5/16″ keyways in spiral gears of 4″ length. Two gears are handled at one time, and as each pair is intended ultimately to operate as a unit, it is essential that the keyseat alignment be perfect.

J. N. Lapointe Co. Broaching Equipment is again the answer, as it is on all particular keyseating jobs, and it takes but 40 seconds for the actual broaching time on a pair of these gears.

The Albaugh-Dover Company of Chicago is noted for quality and speed in gear production. Keyseating, though a small operation, is indeed an important one. This company acknowledges the need of good equipment and employs two J. N. Lapointe Co. Broaching Machines.

Are you aware of the full possibilities of broaching on large and small parts? May we send you the complete story? Write.

THE J. N. LAPOINTE COMPANY
NEW LONDON CONNECTICUT

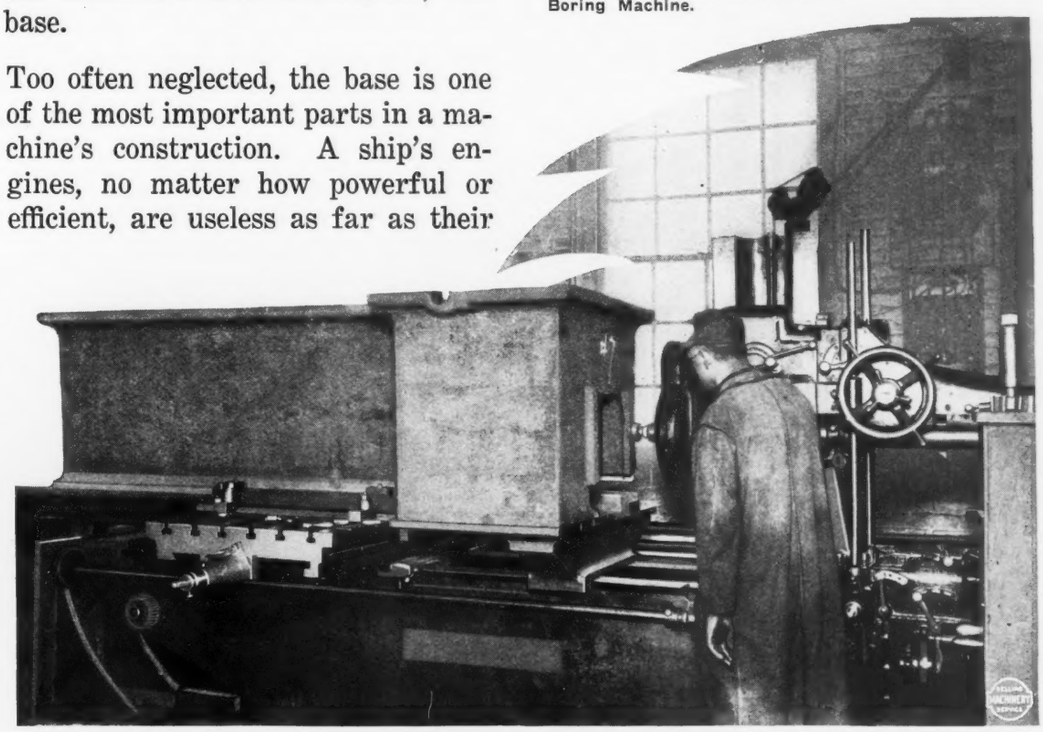
UNIVERSAL
-Horizontal
Boring Machine

A Good Foundation for Your Choice

We have prepared a series of six advertisements, taking you through our plant during the construction of the Universal Boring Machine and showing you the good foundation for making this the machine of your choice. The first picture logically concerns the machine's own foundation, the base.

Too often neglected, the base is one of the most important parts in a machine's construction. A ship's engines, no matter how powerful or efficient, are useless as far as their assistance in navigation is concerned unless the ship's keel has been properly laid. Durability, strength, rigidity and correct proportions are the characteristics of a good machine base. They are instantly apparent in the Universal Boring Machine. Further particulars will convince you. Get them.

The photograph shows the huge close-grained base casting, mounted on an auxiliary table to be end milled and drilled by another Universal Boring Machine.

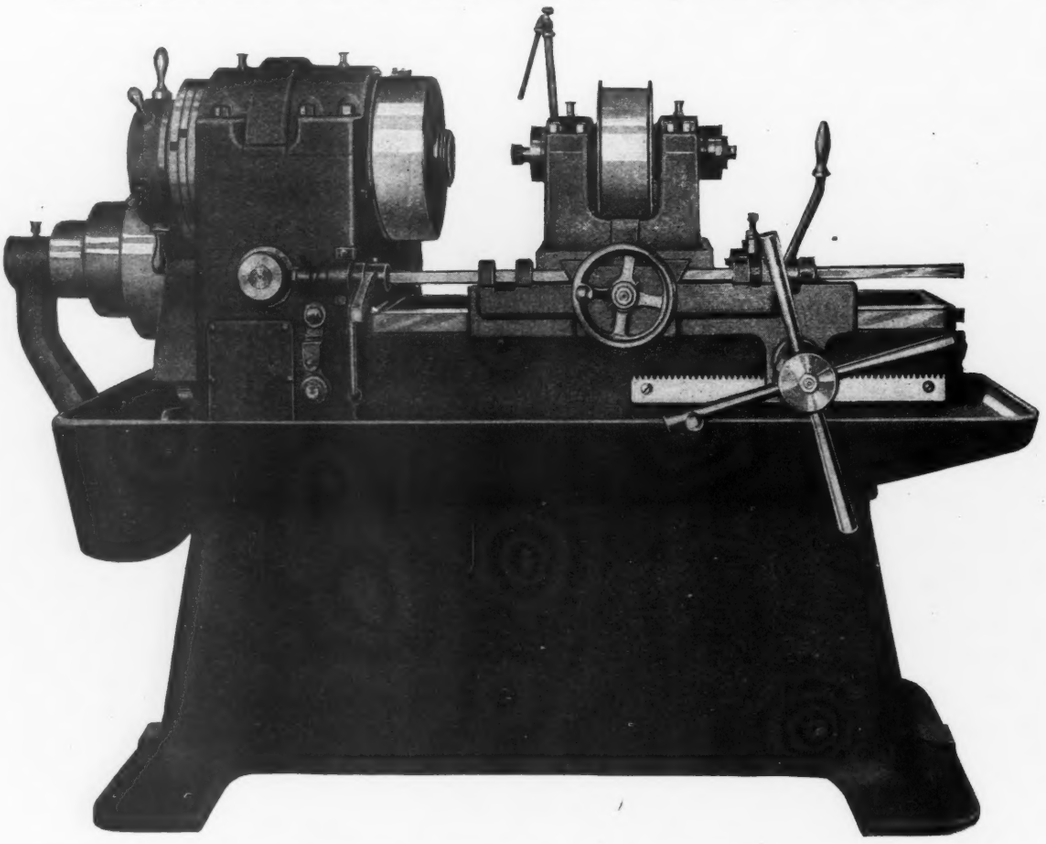


UNIVERSAL BORING MACHINE COMPANY

HUDSON MASSACHUSETTS U. S. A.

The New Biggs-Watterson Thread Miller

Under the old method the operator sometimes forgets. Why not use our Universal Automatic Thread Miller, eliminate all losses and increase your production?



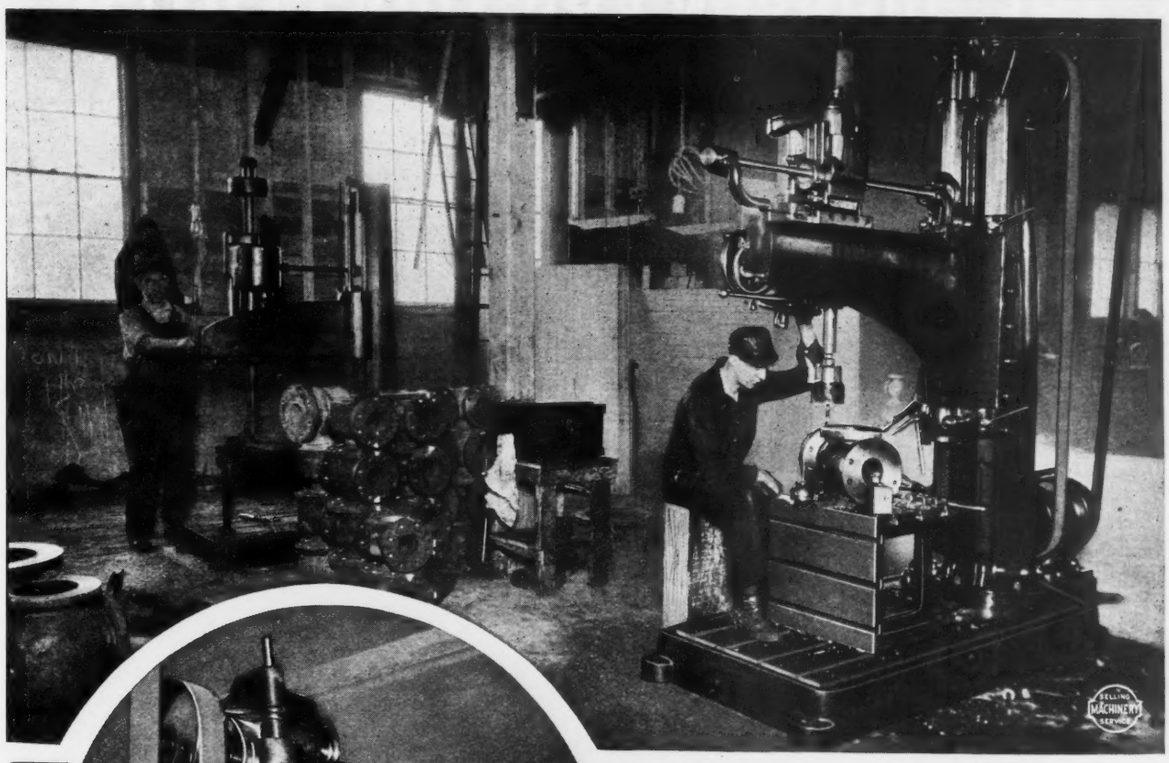
All operating mechanism is automatic. Operator chucks work only.
Prompt deliveries assured. Honest service.

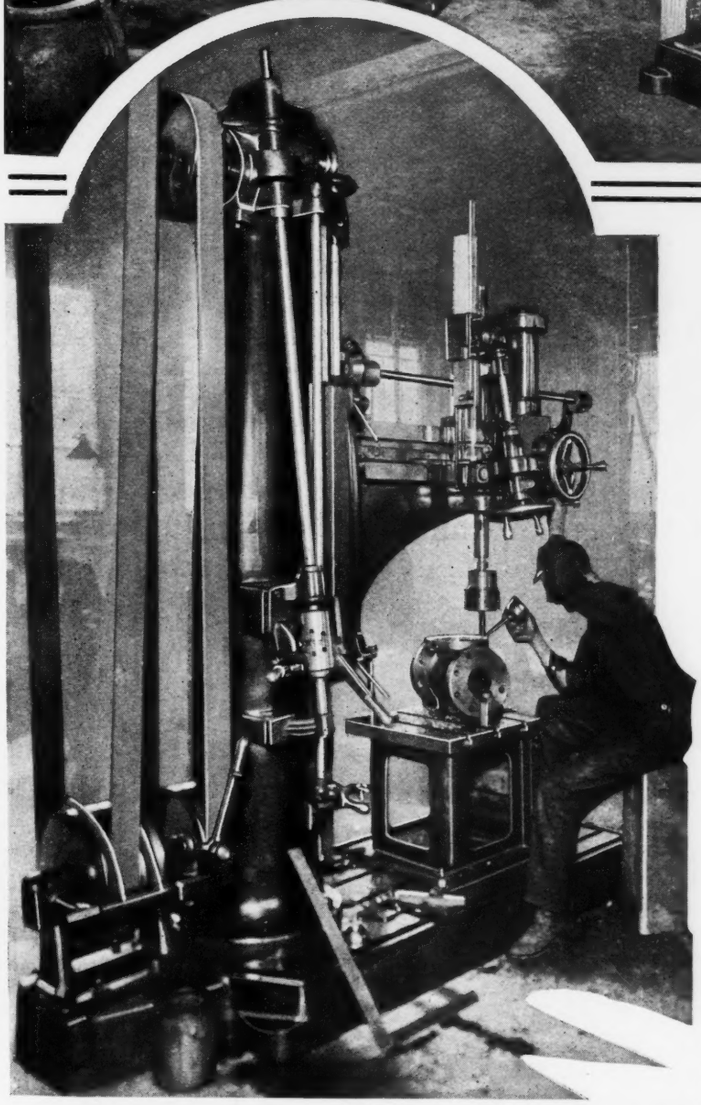
This machine is built in four sizes. The capacity through the spindle or spring chuck can be 3″, 6″, 9″ or 12″. Long pieces are chucked from the back end, while short pieces are chucked from the front.

Machine is controlled by a single lever which engages the drive of work spindle, brings the cutter to proper depth, engages lead screw, and starts lubricant pump. After work spindle completes one revolution, power is disengaged, cutter is backed away, and carriage nut released from the screw, retaining the lead positively. Any threads, either Metric or U. S. Standard, right or left hand, internal or external, can be cut through our system of change gears.

THE BIGGS-WATTERSON CO.

CLEVELAND, OHIO





The WESTERN "RADIAL"

It Made Good Quickly in This Shop

THE Ruggles-Klingemann Mfg. Company, Salem, Mass., bought this Western Radial about two months ago on our recommendation—and it has made good most emphatically. It performs a variety of operations on a wide range of work. It is used on piece work and has got to stand the pace.

The "Western" will make good on any legitimate radial drilling operation. It is a genuinely good machine. We recommend it without qualification.

Let us send complete specifications.

Manufactured by

WESTERN MACHINE TOOL WORKS

Holland Michigan

Manufacturers' Agents

HILL, CLARKE & COMPANY, Inc.

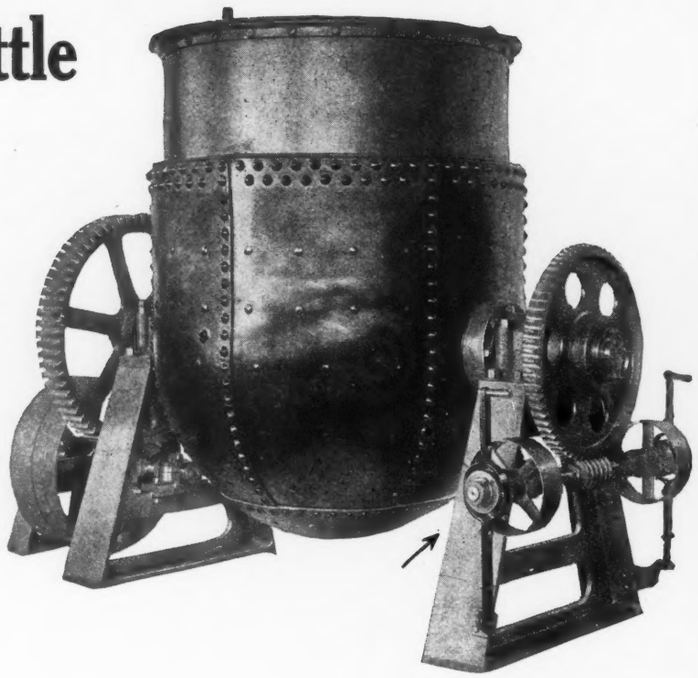
156 Oliver St., Boston, Mass. THE MACHINERY MERCHANTS 136 Cedar St., New York City

THE JOHNSON FRICTION CLUTCH

A Big Steam Kettle

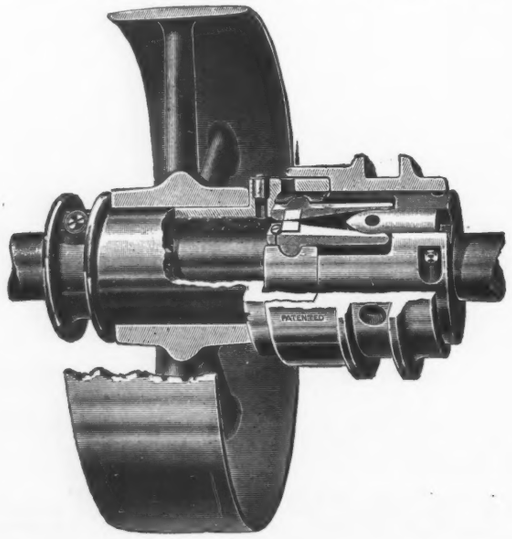
The Action of which Must be Instantaneous

This is a tilting kettle for "cooking" linoleum compositions, and in action it must respond instantly and positively to the wishes of its operator.



The Johnson Friction Clutch Does the Trick

Johnson Clutches are fitted to these kettles because they are dependable clutches—they do what they are required to do, quickly, positively and economically—and more than this you cannot ask of any device. There is no more adaptable device of its class on the market than the JOHNSON FRICTION CLUTCH. We can make it fit anywhere; it answers every friction clutch requirement; it is small, simple, powerful, *safe;* it operates easily and quietly; is absolutely interchangeable; has no bolts, nuts, links, etc.

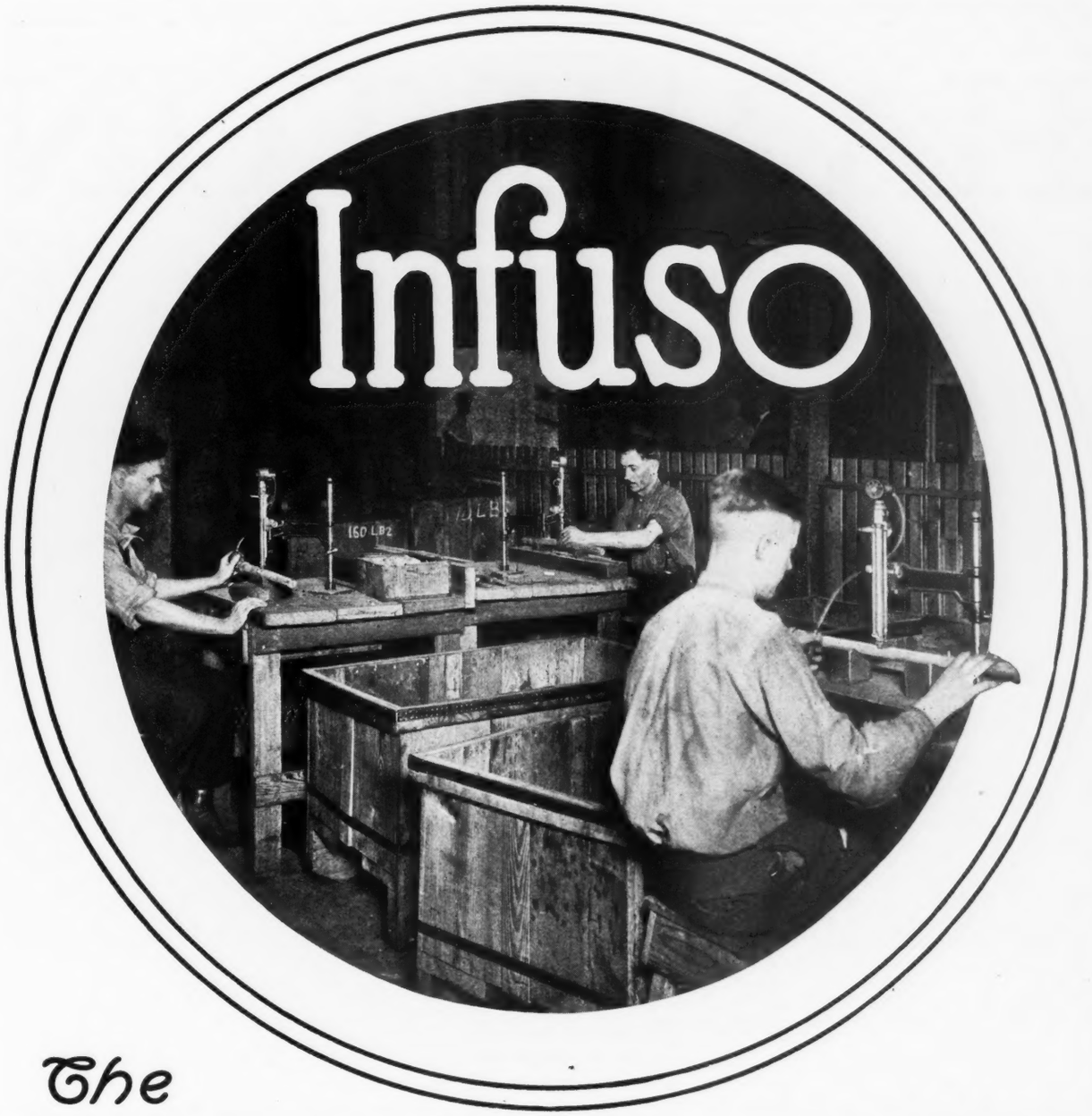


Write now for Catalog A and complete details

AGENTS:

CANADA: Williams & Wilson, 320 St. James St., Montreal. The Canadian Fairbanks-Morse Co., Ltd., Toronto and branches. ENGLAND: The Efandem Co., 22 Newman St., Oxford St., London, W. 1, Sole Agents for British Isles. AUSTRALIA: Edwin Wood, Pty., Hardware Chambers, 231 Elizabeth St., Melbourne, Victoria. JAPAN: Andrews & George Co., 16 Takegawa-cho, Kiobashiku, Tokyo. SOUTH AFRICA: D. Drury & Co., Main St., Johannesburg. FRANCE: Anciens Etab. Glaenzer & Perreaud, 18 Faubourg du Temple, Paris.

THE CARLYLE JOHNSON MACHINE CO. MANCHESTER CONN.



The INFUSO PROCESS

One of Our Secrets---Wide Open to Public Inspection

Proving an answer in mathematics won't make it any more correct than it was, neither will subsequent testing of metal help in its heat treatment.

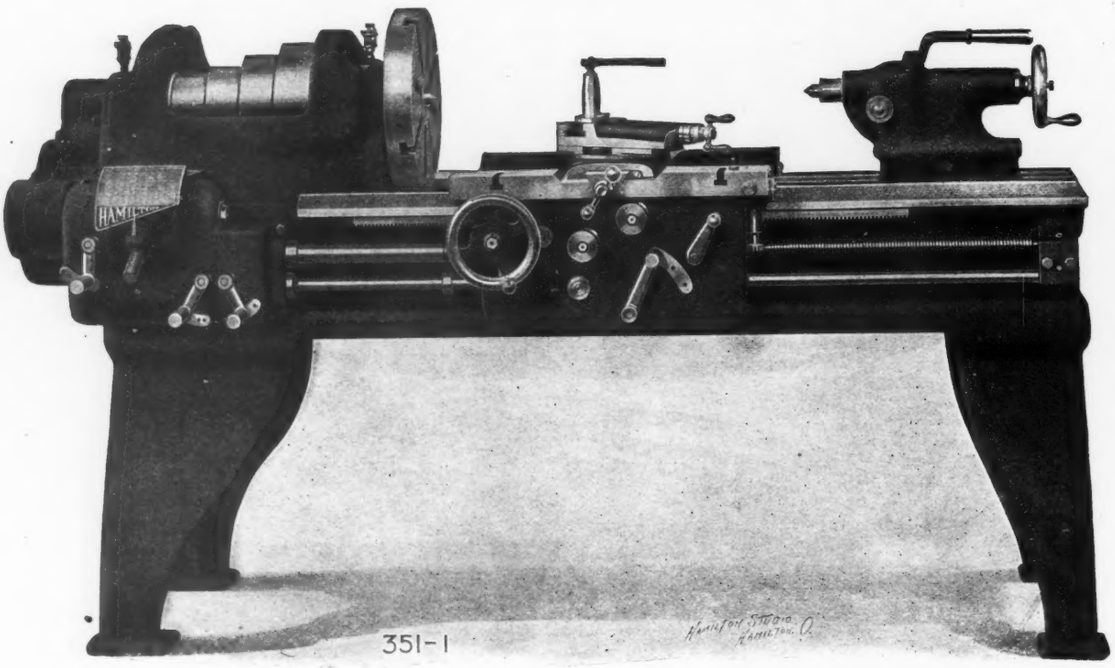
But when you're dead certain you've done a thing correctly, you're glad to have the opportunity to say "I told you so."

That's our only excuse for calling the careful inspection of parts a feature of the Infuso Process. It only proves the correctness of our process.

The Steel Improvement and Forge Company

CLEVELAND OHIO, U. S. A.

HAMILTON



The New 16" Rapid Production Lathe

Rapid Production HAMILTON Machine Tools

The New Hamilton 16″ Rapid Production Lathe combines features which make it the most powerful, accurate lathe of its dimensions on the market. Improved gear box, semi-steel bed with its wide V, box type headstock, chrome-nickel steel spindle, double apron and drop-forged apron gears are a few of the points which insure the accuracy and durability of this up-to-date machine.

Friction is reduced to the minimum by means of a central oiling system of the gear box and apron, sight-feed spindle oilers and bronze bushings throughout. Swings over ways 18¼″.

Bulletin No. 316 gives complete details
Send for a copy

THE HAMILTON MACHINE TOOL CO.
HAMILTON, OHIO, U. S. A.

DOMESTIC AGENTS: Machineshop Equipment Corp'n. Boston, Mass. Machine Tool Engr. Co., New York. Syracuse Supply Co., Rochester, N. Y., Syracuse, N. Y., Buffalo, N. Y. Sherritt & Stoer Co., Philadelphia, Pa. Laughlin-Barney Mchy. Co., (Lathes), Pittsburgh, Pa. J. S. Miller Mchy. Co. (Planers), Pittsburgh, Pa. Cooperative Machinery Co., Cleveland, O. Osborne & Sexton Mchy. Co., Columbus, O. Wolverine Machinery & Supply Co., Detroit, Mich. Stocker-Rumley-Wachs Co., Chicago, Ill. Thomson Tool & Supply Co., Indianapolis, Ind. W. C. Johnson & Sons Mchy. Co., St. Louis, Mo. F. E. Satterlee Co., Minneapolis, Minn. Hendrie & Bolthoff Mfg. & Supply Co., Denver, Colo. General Machinery & Supply Co., San Francisco, Cal. Herberts Machinery & Supply Co., Los Angeles, Cal. M. J. Walsh Mchy. Co., Milwaukee, Wis. Textile Mill Supply Co., Charlotte, N. C. Cotton States Belting & Supply Co., Atlanta, Ga. Oliver H. Van Horn, Inc., New Orleans, La. CANADIAN AGENTS: H. W. Petrie, Ltd., Toronto, Ont.

WILLIAMS' "AGRIPPA" TOOL HOLDERS

BACK OF THE FRONT OVER HERE AND "OVER THERE"

The mechanical advantages which gave Williams' "AGRIPPA" Tool Holders the preference over other tool holders at San Francisco in 1915 continue to give them a like preference in the demand for government service in 1918.

One by one, from the British Empire, from France, Italy, Russia and Japan came the war calls for the "AGRIPPA" —The Modern Tool Holders—and they went forth.

Now Hear America's Call! She too must save time, labor and high-speed steel, and our Government has therefore

Drafted the "AGRIPPA" by the Thousands

for use overseas and at home, because they alone save the most machine time on the job, lose the least repair time off the job and need the least shifting between the jobs.

They're "doing their bit"—they'll make yours easier.



A tool that performs both cutting-off and side work by the mere substitution of suitable cutters tells its own story of economy.



The Threading Tool with lockable-spring head will do roughing, finishing and threading at one setting of the tool post.

J. H. WILLIAMS & COMPANY

"The Drop-Forging People"

61 Richards St., Brooklyn, N. Y.

Western Office and Warehouse: 61 So. Clinton St., Chicago



The Boring Tool takes any size or shape of bar and requires no bushings.



The Planing Tool's serrated ring affords varied and rapid adjustment. The ring is hardened against wear. The body is heat-treated to prevent breakage.

CARD TAPS

The CARD Quality



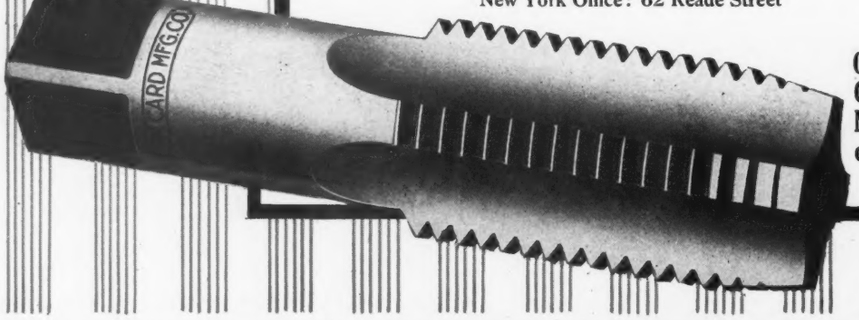
CARD Taps are on the Honor Roll, lined up with the nation's best in men, machines and tools; doing their part to carry on successfully the most tremendous task the American people have ever undertaken; economically cutting the clean, true threads required for high grade work.

The Card line, providing for every thread cutting requirement, includes Taps, Dies and Screw Plates—every tool made by experts, every tool guaranteed for quality and workmanship. Forty-four years on the market.

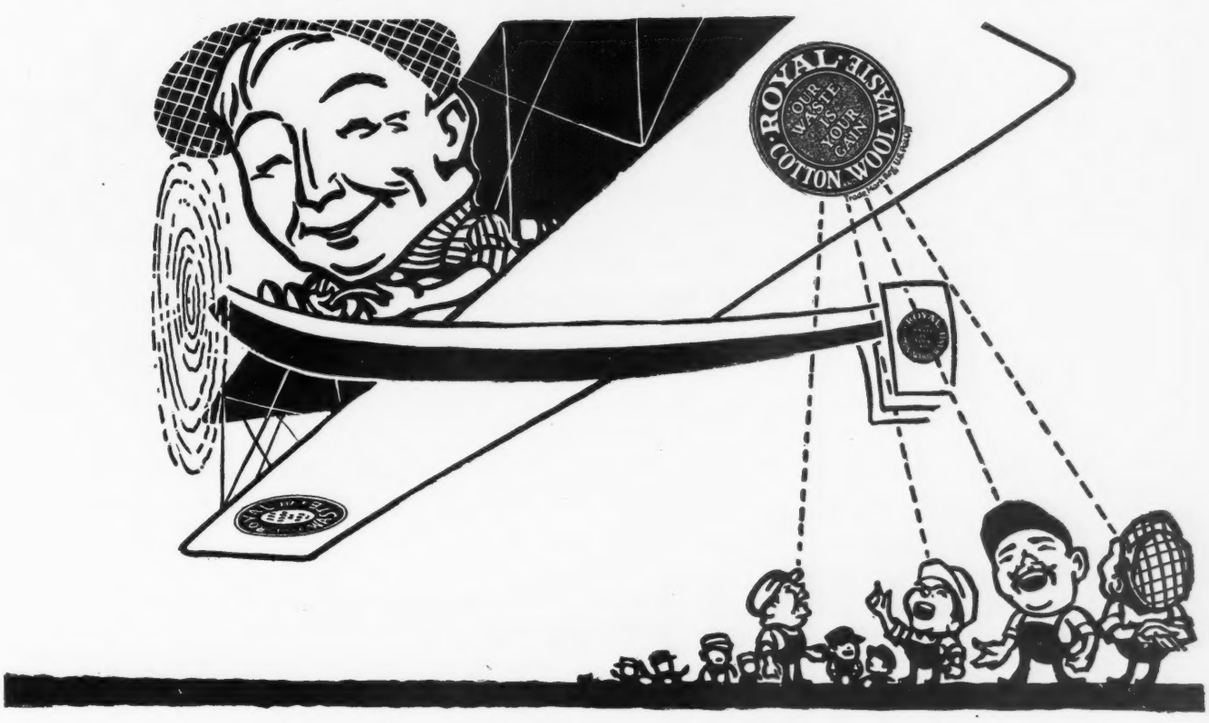
S. W. CARD MFG. CO.

MANSFIELD MASS., U. S. A.

New York Office: 62 Reade Street



Our latest Catalog No. 29 on request



Above all, remember R-o-y-a-l

DON'T be like the man who knew a nice girl but forgot her 'Phone number. Don't forget the trade mark on that baleful of cotton waste that satisfied you down to the last handful.

—that was so absorbent
—that was so free of dirt and splinters
—that proved its standardization by guarantee of uniform quality, even weight and 6% "tare" (wrappings).

Say to the buyer "I want Royal."

Don't forget which of the 12 Royal grades proved best for your need of service and price.

If it was WHITE, it was Baron, Count, Czar, Duke, Earl or Emperor.

If COLORED, it was King, Marquis, Mikado, Prince, Rajah or Sultan.

Write us for the great little book, "Producing the Fittest in Waste." Ask your jobber or us for Royal Sampling Catalogue or for samples of resilient Royal Wool Waste. The imposing Royal Magazine Campaign is worth your notice.

ROYAL MANUFACTURING Co

ROYAL · OUR WASTE IS YOUR GAIN · COTTON AND WOOL WASTE

General Sales Offices and Plant
RAHWAY, N. J.
LOOK FOR THE BRAND ON EACH STEEL BAND

New York Office—2 Rector Street
St. Louis Office—Pontiac Bldg.
Chicago Office—People's Gas Bldg.
Pittsburgh Office—Oliver Bldg.
San Francisco Office—Wells Fargo Bldg.

Your Countershafts Can Also Be Improved—

WHEREVER you have a high-class machine connected up to an old-fashioned plain bearing countershaft there is a double loss—loss of production and loss of power.

The Rockford Drilling Machine Company has permanently solved its countershaft problems by equipping countershafts with Hyatt Roller Bearings. So can you.

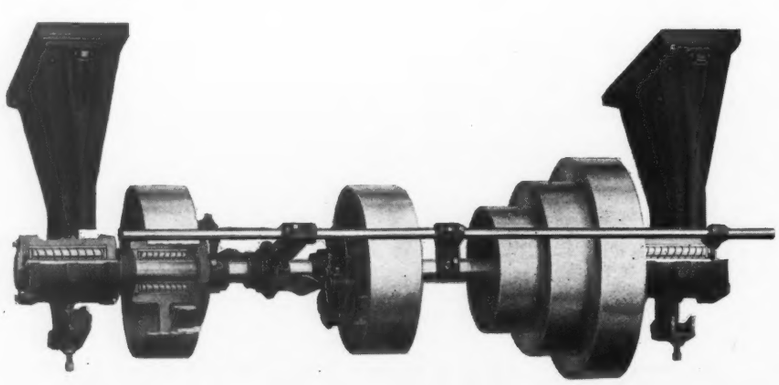
Hyatt Roller Bearings insure smooth and dependable operation at all times. By eliminating at least 50 per cent of the friction of plain bearings, they speed up shop production and reduce power and lubrication expenses wherever they are used.

You can get many years of satisfactory service from a Hyatt Roller Bearing Countershaft. The only attention it requires is a single charge of lubricant three or four times a year.

The manufacturers of machine tools of all kinds are now furnishing Hyatt Roller Bearing equipped countershafts as a standard part of their product and have thereby improved machine tool operation to a profitable extent.

You can obtain Hyatt Roller Bearing equipped countershaft boxes and unbreakable steel hangers from the Standard Pressed Steel Company and complete Hyatt Roller Bearing equipped countershafts with Standard Clutch from the Standard Pulley Company. Hyatt Roller Bearing equipped countershaft clutches are furnished by the Foster Machine Company, the Brown Engineering Company and the Edgemont Machine Company.

You will find that our Countershaft Bulletin contains complete engineering data of real practical value to you. Send for it today.



HYATT BEARINGS

Rockford Drilling Machine Co.

Manufacturers of

Upright, Horizontal and Gang Drills

Rockford, Ill., April 29, 1918.

The Hyatt Roller Bearing Co.
Industrial Bearing Division,
New York City, N.Y.

Gentlemen:

Replying to your favor of the 25th inst., will say that these are to be used in pairs as bearings for a countershaft running at about 400 RPM.

We have had more or less trouble with this particular countershaft and have finally come to the conclusion that the only way to eliminate this trouble is to provide same with roller bearings. The load is nominal and well within the load specified in the tabulation contained in your favor the 25th.

We intend to make up hardened sleeve on which two bearings will run, the bearings and sleeve to be contained in an outside raceway. We have already made up one countershaft of this style. This last countershaft had been giving us a great deal of trouble as it ran approximately at 1100 RPM and transmitted approximately 10 H.P. We finally came to the conclusion that Hyatt Bearings would be the only solution to our trouble.

This countershaft has been running approximately six months and has convinced us in a case of this kind, that we have only one solution---to apply Hyatt Roller Bearings to overcome our troubles.

Yours truly,

Rockford Drilling Machine Co.

E. K. Morgan.

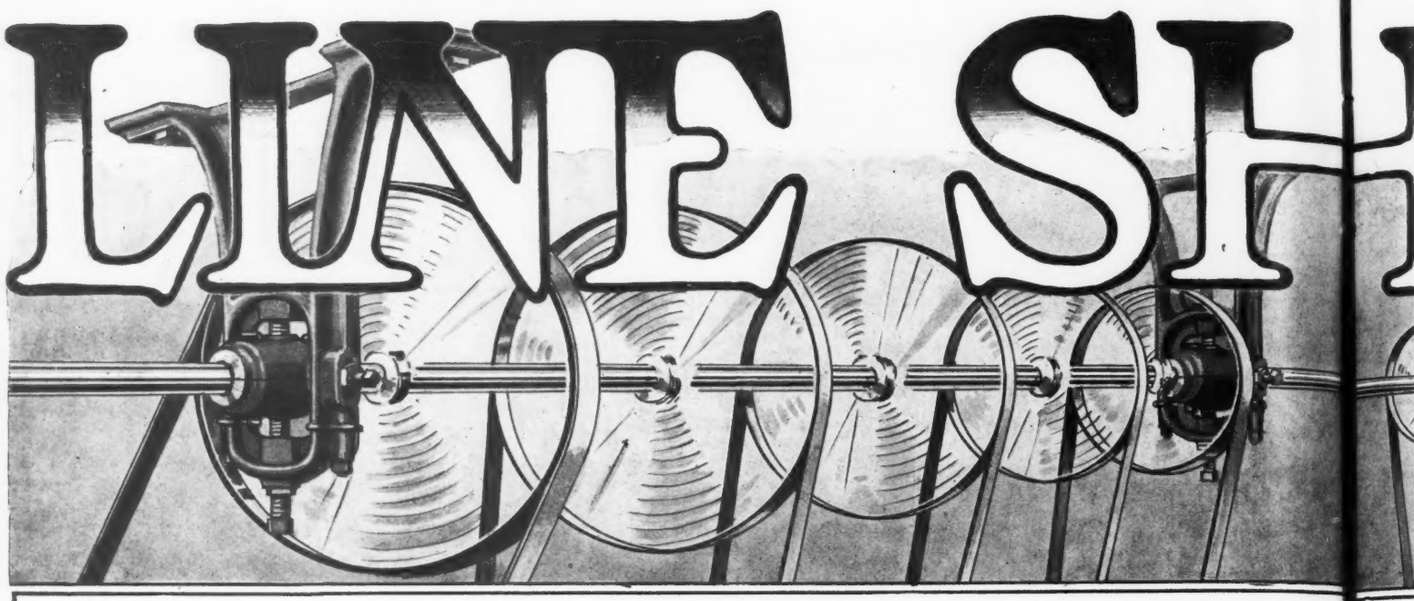
EKM/AMF. Gen Supt.

HYATT ROLLER BEARING CO., Metropolitan Tower, New York

Manufacturers of bearings for steel mill cars and roller tables, trolleys, cranes, hoists, machine tools, line shafts, concrete machinery, all kinds of trucks and cars, textile machinery, conveyors, etc.

425

FOR COUNTERSHAFTS



HOW MANY LINE SHAFT HANGERS ARE THERE IN YOUR PLANT?

If every hanger in your plant consumes one horse power in friction every ten hour day, how much power do you waste in one year and what does it amount to in tons of coal or in dollars and cents?

Engineering tests have shown that the usual babbitted hangers waste at least 30 per cent of your total power. At least 50 per cent of this waste can be eliminated by the use of Hyatt Line Shaft Roller Bearings. Thus your total power bill can be reduced 15 per cent or you can run additional equipment with your present power plant.

Hyatt Line Shaft Roller Bearings provide a true rolling motion in place of the dragging friction of babbitted bearings. The hollow flexible steel rollers revolve directly on the shaft without the need of inner sleeves.

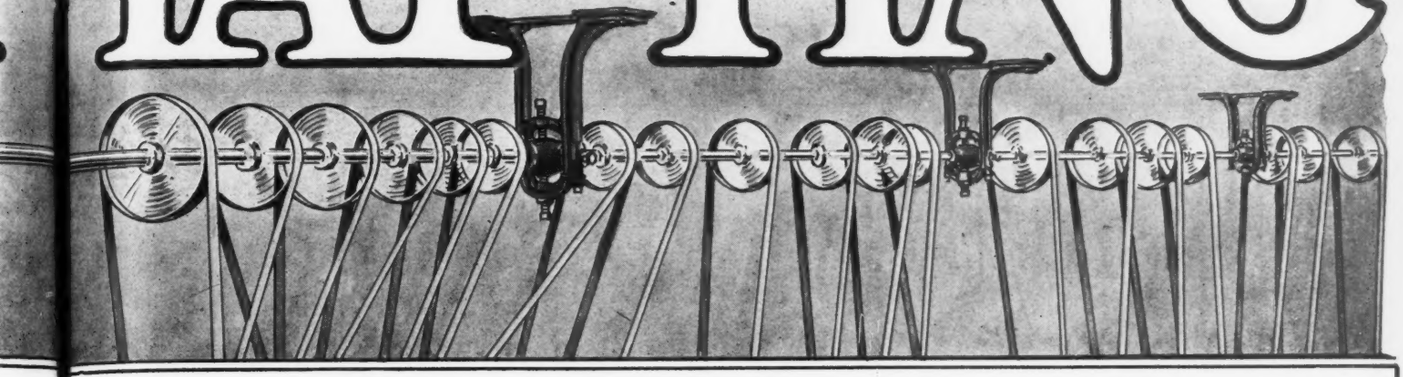


The Hyatt Line Shaft Box, assembled.

Note the flexible rollers within and how box is completely split.

HYATT BEARINGS

HAFTING



Hyatt Line Shaft Roller Bearings are SPLIT throughout and can therefore be slipped easily into position on a shaft without removing any pulleys, collars or couplings.

These easily applied line shaft bearings hold sufficient oil for several months lubrication and the helical openings in the rollers constantly bathe the surfaces in oil.

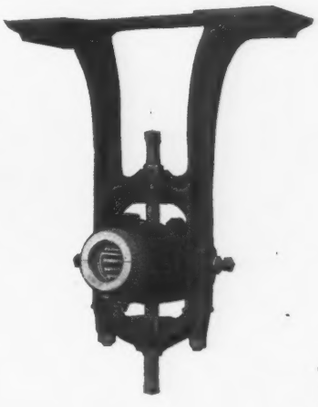
The first cost of a Hyatt Line Shaft Roller Bearing is very little more than the first cost of a babbitted bearing. The maintenance cost is far less and the replacement cost practically zero, for Hyatt Bearings have been in operation in some plants for 25 to 30 years and are still giving satisfactory service.

It will pay you to stop the power waste in your plant, by the use of Hyatt Line Shaft Roller Bearings. Send for our complete Line Shaft Bearing information today.

HYATT ROLLER BEARING COMPANY

Metropolitan Tower, New York, N. Y.

Manufacturers of bearings for steel mill cars and roller tables, trolleys, cranes, hoists, machine tools, line shafts, concrete machinery, all kinds of trucks and cars, textile machinery, conveyors, etc.



A 109

FOR LINE SHAFTS

CHARD

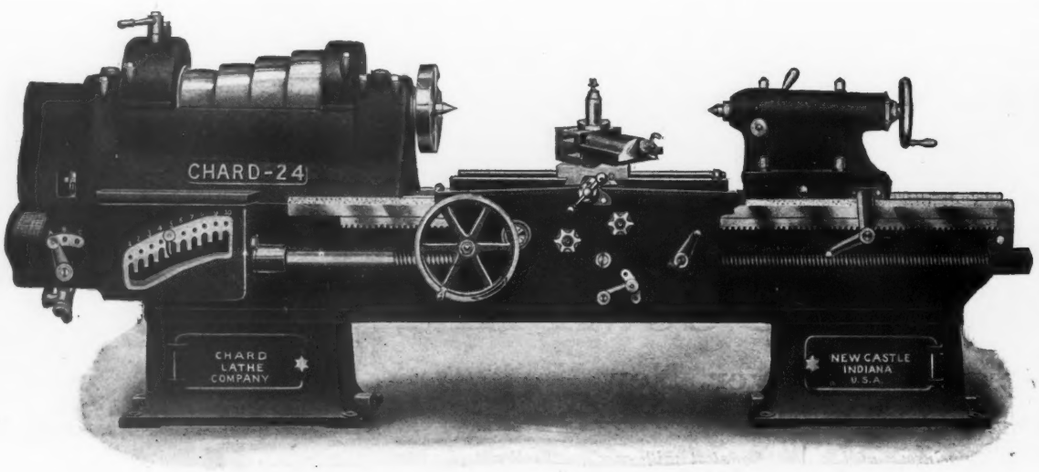
LATHES OF HIGHEST QUALITY

APRON is of double plate construction, permitting the use of gear studs revolving in the plates and eliminating fixed studs on which gears run loose.

All studs in back plate are oiled from one point in top of carriage. A non-interfering device prevents both feeds being engaged simultaneously. All feeds are reversed in the apron.

Every part of the Chard Lathe is designed and constructed to stand the "greater-than-usual" strains.

Bulletins give complete details—the five sizes—16-in. to 28-in. swing. Write us.



CHARD LATHE COMPANY

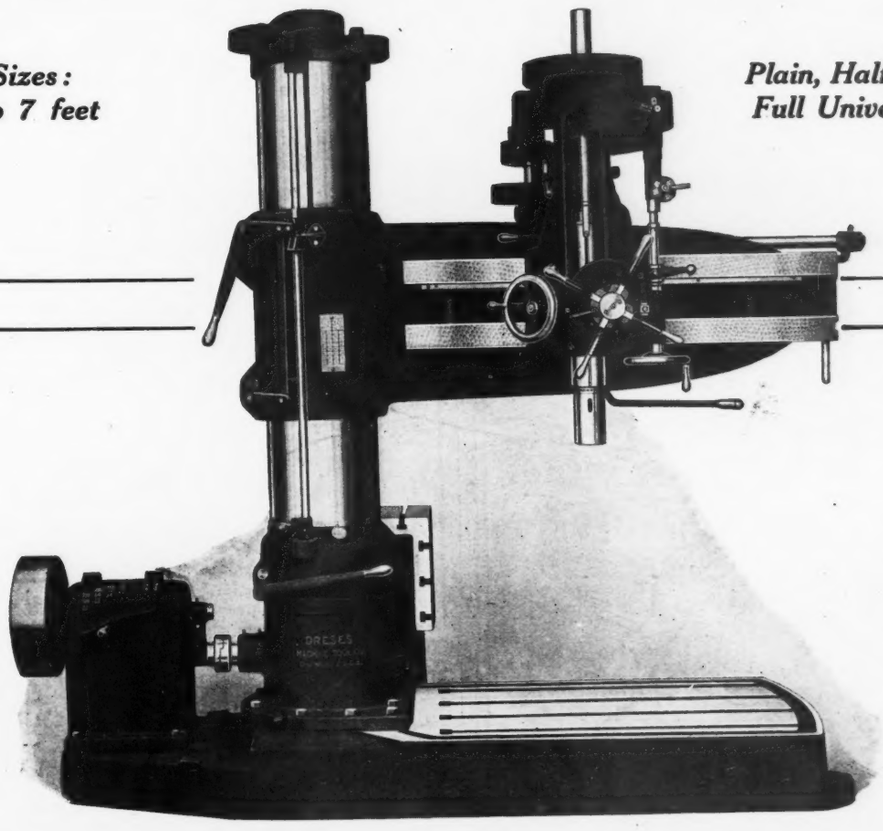
NEWCASTLE, INDIANA, U. S. A.

AGENTS: Vonnegut Machinery Co., Indianapolis, Ind. English & Miller Machinery Co., Detroit, Mich. The W. M. Pattison Supply Co., Cleveland, Ohio. Ogden R. Adams, Rochester, N. Y. The F. O. Stallman Supply Co., San Francisco, Cal. J. S. Miller Machinery Company, Pittsburgh, Pa. Monarch Machinery Company, Philadelphia, Pa.

Originality in Design Distinguishes the New Line of "Dreses" Radials

Sizes:
3 to 7 feet

Plain, Half and Full Universal



Here Are a Few of the New Features

Pulley shaft on speed variator has annular ball bearing, gears are of steel and hardened and run in oil baths.

Base has oil groove so designed to increase the working surface.

Column is greatly enlarged at lower end and has a third bearing in the middle, doubling the strength and rigidity.

Arm has double webbed box shaped lower rib, preventing twisting.

Head has a third bearing in the rear, adding to the support, preventing bending and straining of rear shaft and rapid wear of bevel gears and bearing.

Friction bevel gears and worm wheel run in oil bath.

Quick return has four levers serving as pilot wheel to move spindle; each lever engages and disengages the feed.

Friction for starting, stopping and tapping is double expanding, powerful in gripping, easy to operate and adjust.

Steel gearing, hardened; phosphor bronze bushes; ball bearings in all places essential.

High spindle speeds.

Least friction and power consumption.

DRESES MACHINE TOOL CO., Cincinnati, Ohio

REPRESENTATIVES: Manning, Maxwell & Moore, Inc., New York, Boston, Philadelphia, Cleveland, Chicago, Detroit, Mexico City; Carey Machinery and Supply Co., Baltimore; William C. Johnson & Sons Mchy. Co., St. Louis; Pacific Tool & Supply Co., San Francisco and Los Angeles; Stussi & Zweifel, Milan; R. S. Stokvis & Zonen, Rotterdam; R. S. Stokvis & Fils, Paris and Brussels; Alfred Herbert, Ltd., Coventry; Shewan Tomes & Co., Shanghai, Peking and Canton.

Foote-Burt High Duty Drills

Machines You are Going to Need



Write for the Bulletin before you order drilling equipment

With all the forces of the United States organized for offense and defense, American manufacturers are facing the busiest and most important period of industrial history. Their prime need is machines—good machines, machines built like the Foote-Burt No. 25 High Duty 24″ Drilling Machine.

The No. 25 is as rigid as a machine can be made, modern to the smallest detail, and drives high speed drills, up to 3″ size, to full cutting edge capacity. All speed and feed changes are made through quick change gear device of special design; spindle is of forged high carbon steel, fitted with ball bearing thrust of our own design, *guaranteed not to crush under the severest duty.* All levers are within easy reach. Briefly, the function of this machine is to work hard and keep at it.

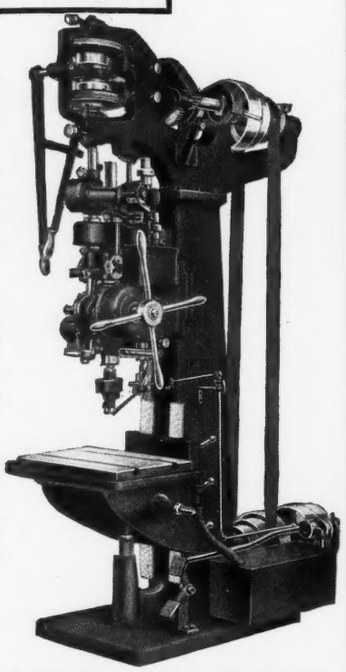
THE FOOTE-BURT CO., Cleveland, Ohio

MILWAUKEE OFFICE: 633 Wells Building.

DETROIT OFFICE: 1457 David Whitney Building.

FOREIGN AGENTS: Buck & Hickman, Ltd., London, Birmingham, Manchester and Glasgow. Moscow Tool & Engine Co., Moscow. Ing. Ercole Vaghi, Milan. R. S. Stokvis & Zonen, Ltd., Rotterdam. R. S. Stokvis & Fils, Brussels. Glaenzer & Perreaud, Paris, agents for France, Switzerland, Spain and Portugal. Benson Bros., Ltd., Sydney. Australia, agents for Australia and New Zealand. Mitsui & Co., agents for Japan, Korea and Manchuria.

THE TURNER TURRET



This machine performs a number of operations in rapid sequence, thereby saving time, waste motion and, in addition, does not require a skilled workman.

Second operations that so frequently run up costs can be performed with one chucking.

Sturdy, strong, safe, it is an indispensable adjunct of the modern shop.

Write for catalog

TURNER MACHINE COMPANY

DANBURY, CONN. and NEWARK, N. J., U. S. A.

Incorporated with Turner, Atherton & Co., Ltd. Denton, Manchester and Stockport, England

Before You Buy a Special Machine

Give the Covington Multiple Drill Head No. 3 a chance. Capacity for eight holes or less, quickly, economically, simultaneously. Spindles are simply adjusted and perfectly rigid.

COVINGTON Multiple Drill Heads

Free Trial *Send for full details*

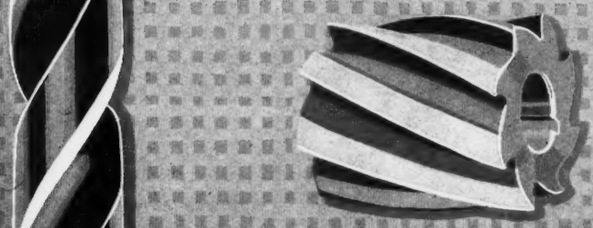


COVINGTON MULTIPLE DRILL CO.

2449-53 W. McMicken Ave. CINCINNATI, OHIO

National

Twist Drills & Tools



Represent the best engineering thought and are *all* that drills and tools should be

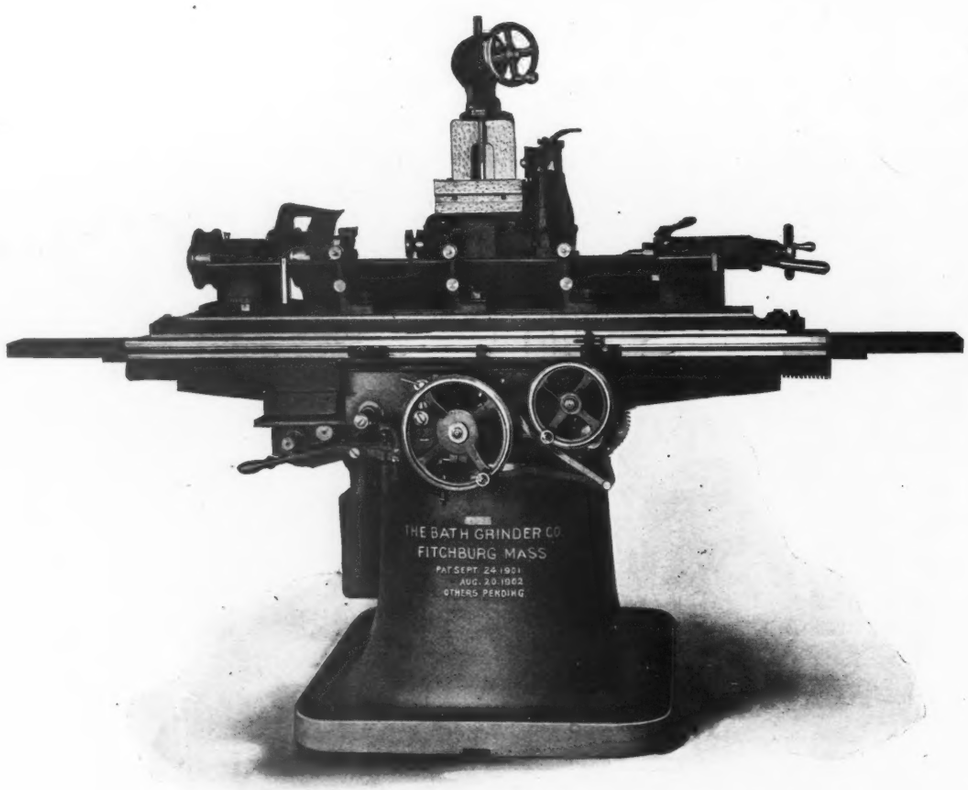
National Twist Drill & Tool Co.
Detroit U·S·A·



NEW YORK OFFICE — 30 CHURCH ST. CHICAGO OFFICE — 104 S. JEFFERSON ST.

BATH UNIVERSAL GRINDING MACHINE

For Cylindrical, Surface, Internal, Tool and Cutter Grinding



MADE IN 3 SIZES

No. 1. 10" Swing, 20" between centers, Wheel 10 x ¾
No. 2. 10" Swing, 25" between centers, Wheel 12 x 1½
No. 2½. 10" Swing, 36" between centers, Wheel 12 x 1½

BUILT BY

UNIVERSAL GRINDING MACHINE COMPANY

FITCHBURG, MASSACHUSETTS, U. S. A.

AGENTS: The Fairbanks Co., New York City, Albany, Syracuse, Utica, Buffalo, Boston, Hartford, Newark, Philadelphia, Scranton, Baltimore, Birmingham, Ala. New Orleans. The Chas. A. Strelinger Co., Detroit. The E. L. Essley Mchy. Co., Chicago. The W. M. Pattison Supply Co., Cleveland. The National Supply Co., Toledo. Laughlin-Barney Mchy. Co., Pittsburgh. Brownell Mchy. Co., Providence. Hallidie Machinery Co., Seattle. W. H. Savage, Fitchburg. Alfred Herbert, Ltd., Coventry and Yokohama. George E. Fogarty, Paris. Nielsen & Winther, Copenhagen. American Machinery Syndicate, New York and Barcelona, Spain.

RADICAL

FITCHBURG AUTOMATIC MACHINE WORKS

FITCHBURG, MASS.

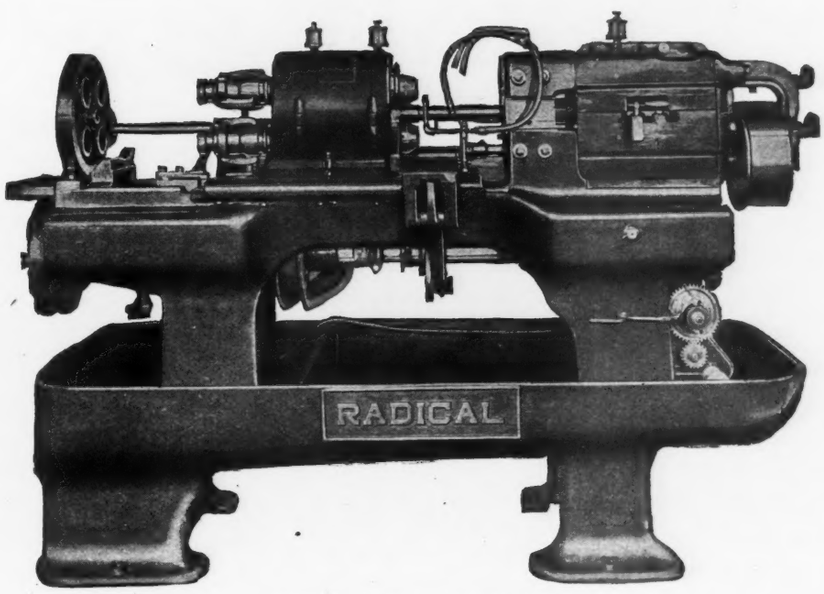
Holding the Drive!

WHERE?

Where the drive for production is greatest—where the strain of continuous operation is most severe—*there* the reserve strength, rigidity and dependability of the

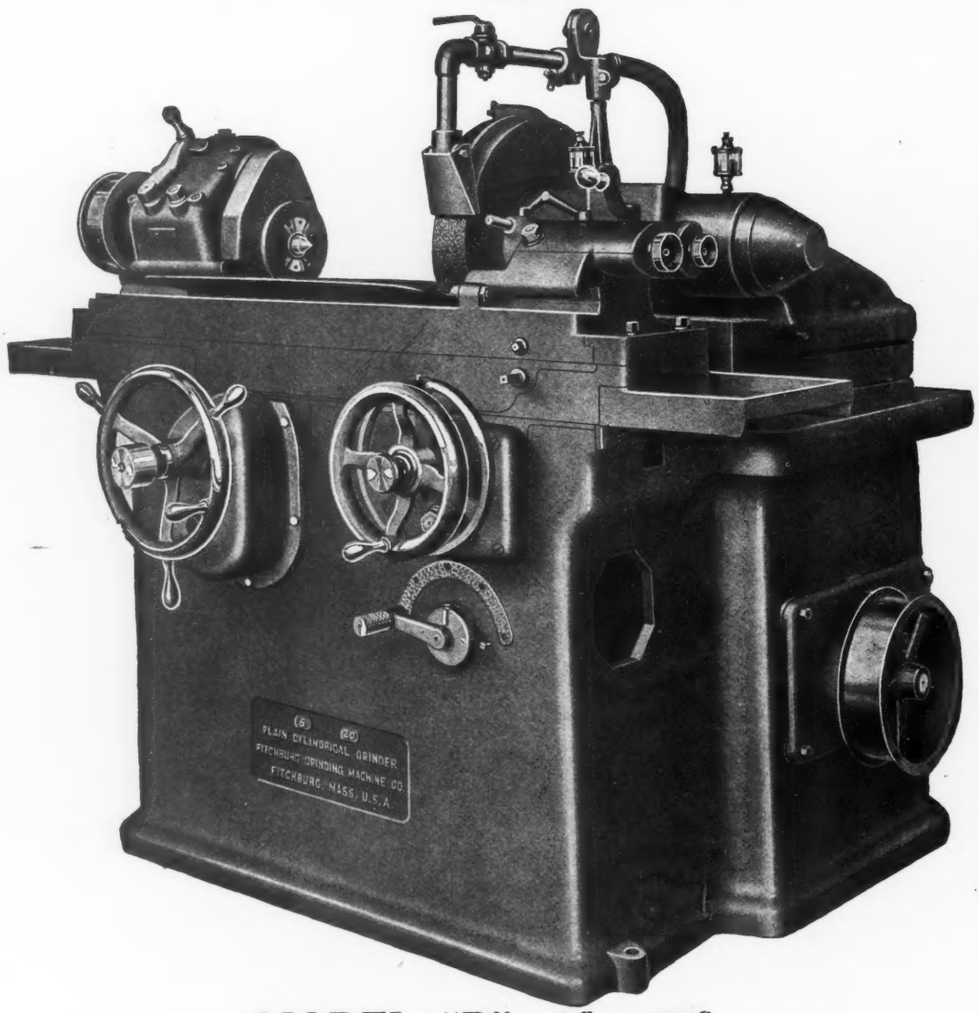
RADICAL AUTOMATIC

Is Holding and Helping



THE RADICAL AUTOMATIC

FITCHBURG GRINDER



MODEL "B"—6" x 20"

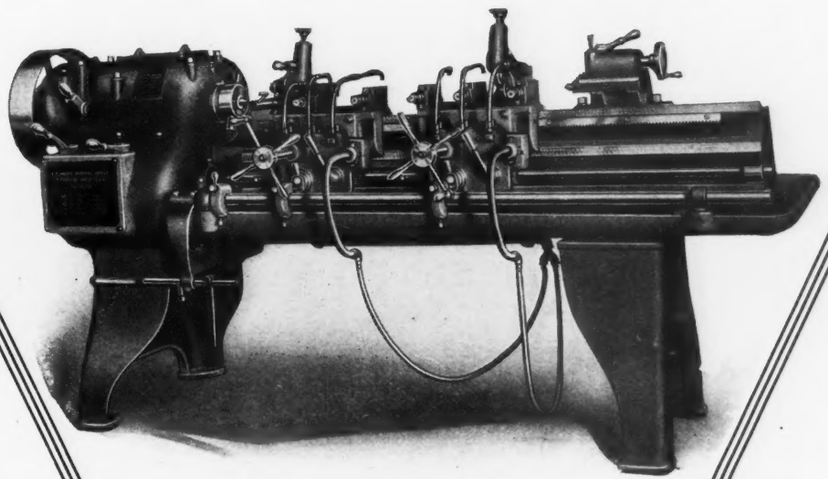
MODEL "A"—POWER TABLE TRAVERSE **MODEL "B"—HAND TABLE TRAVERSE**

	Model A	Model B
Swing over Table (Maximum)	7½"	7½"
Distance between centers	20"	20"
Swivel Table Graduated to angle of	10°	10°
Swivel Table Graduated to Grind Taper per foot	4"	4"
Head and Footstock Spindles bored to fit Morse Taper	No. 4	No. 4
Number of Work Speeds	(10)	(10)
Number of Traverse Table Feeds	(10)	
Number of Grinding Wheel Speeds	3	3
Size of Grinding Wheel	16" x 3"	16" x 3"
Size of Grinding Wheel Pulley	6" x 4"	6" x 4"
R. P. M. of Tight and Loose Pulley	640	640
Horse Power Required	7½ to 10	7½ to 10
Floor Space Required	52" x 66"	52" x 66"
Net Weight of Machine, about	5000	4700
Weight Skidded, about	5600	5300
Weight Boxed for Export, about	6300	6000

FITCHBURG GRINDING MACHINE CO., 76 WINTER STREET FITCHBURG, MASS., U.S.A.

FITCHBURG

Lo-swing LATHES

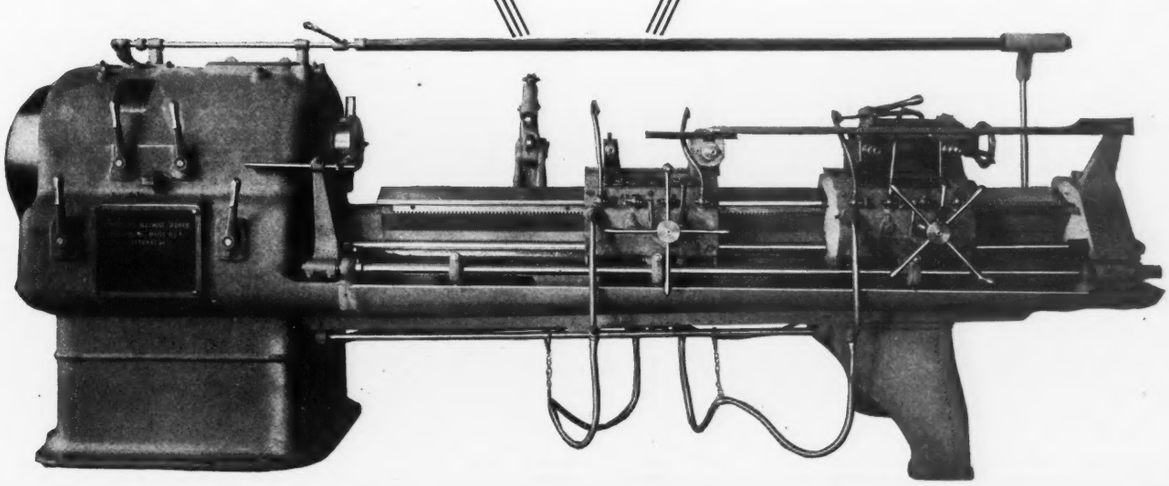


Unsurpassed For Shell Turning

Easy and Economical to Operate

SATISFACTORY DELIVERIES
Send for Full Details

FITCHBURG MACHINE WORKS
FITCHBURG, MASS., U. S. A.



The denseness, toughness and wear-resisting qualities

of Non-Gran are as uniform as the fixed processes by which this bronze is alloyed.

In every machine shop where Non-Gran has replaced nondescript bearing bronzes it has laid bare the fallacy of "different alloys for different purposes" and substituted certainty for *uncertainty* of result.

HIGH SPEED
NON-GRAN
BEARING BRONZE

American Bronze Corporation

Berwyn Pennsylvania

Forging to Victory

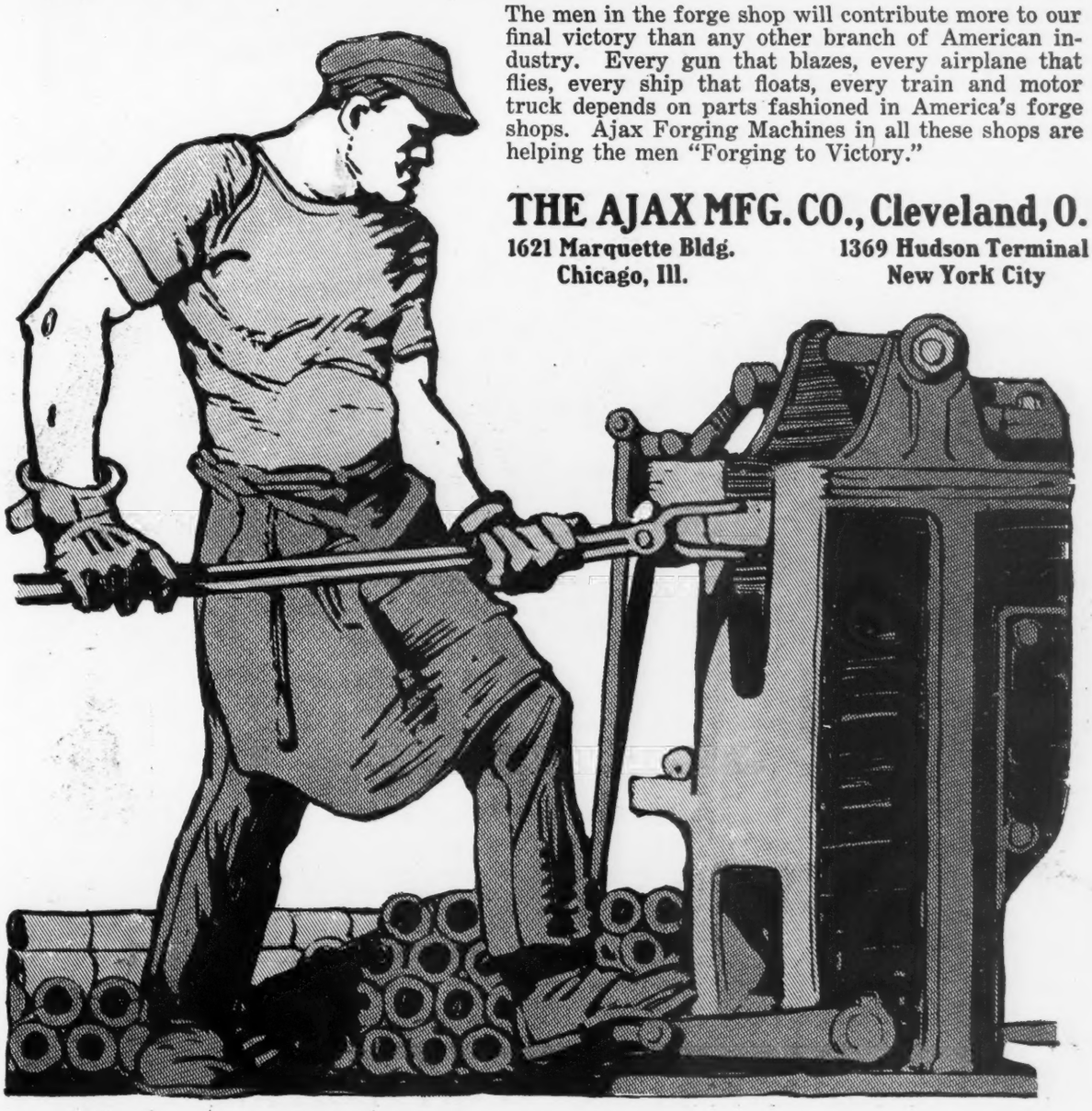


The men in the forge shop will contribute more to our final victory than any other branch of American industry. Every gun that blazes, every airplane that flies, every ship that floats, every train and motor truck depends on parts fashioned in America's forge shops. Ajax Forging Machines in all these shops are helping the men "Forging to Victory."

THE AJAX MFG. CO., Cleveland, O.

1621 Marquette Bldg.
Chicago, Ill.

1369 Hudson Terminal
New York City



AJAX

Forging Machinery

Show this advertisement to the men in your shop. Let them see how victory depends on the forge shops as well as the soldiers.

WINNER OF THE ONLY GRAND PRIZE
AWARDED AT THE PANAMA-PACIFIC EXPOSITION
IN THE TOOL HOLDER CLASS



SAVE
STEEL,
TIME and
FORGING

ARMSTRONG
TOOL HOLDERS

LIKE
THE FRENCH "75"
FIELD GUNS

THEY HAVE MADE GOOD

NO OTHER TOOL HOLDER HAS SUCH A LONG, UNBROKEN RECORD OF SUCCESS; NO OTHER HAS SAVED AND EARNED SO MANY DOLLARS IN THE WORLD'S MACHINE SHOPS.

Catalog Mailed Free

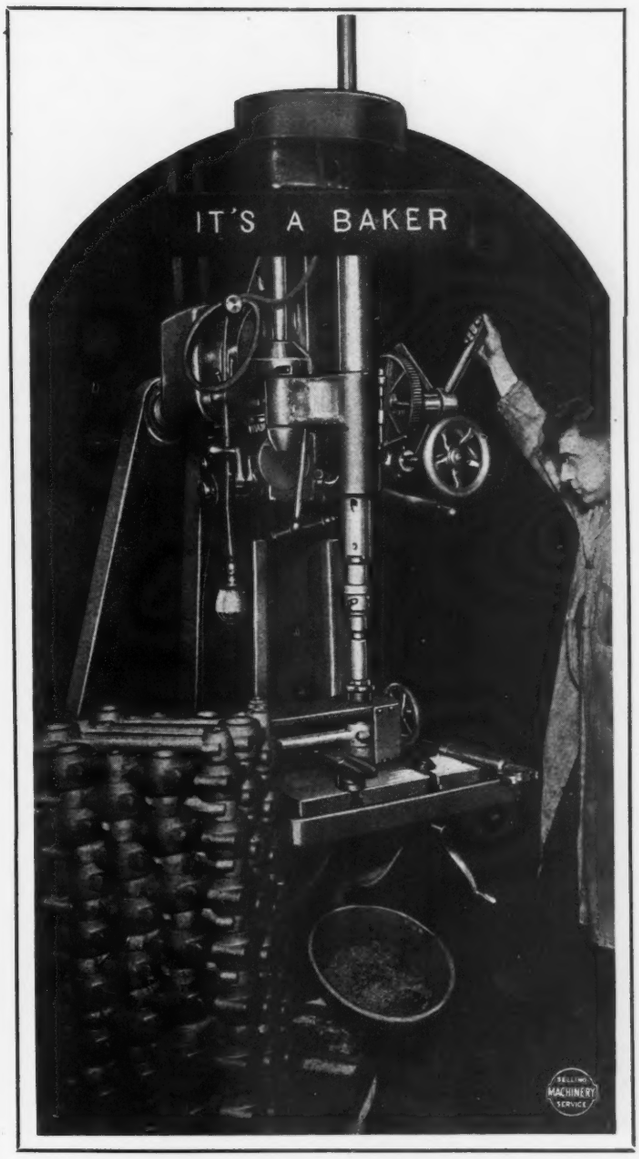
ARMSTRONG BROS. TOOL CO.
"THE TOOL HOLDER PEOPLE"
313 N. FRANCISCO AVE. CHICAGO, U.S.A.

"It's a Baker"

On a Connecting Rod Job

This operator is drilling and reaming holes in connecting rods for high-duty motors—four changes required. Holes are 2⅝ and 1¼ inches diameter, respectively, and by the time the larger has been drilled for 2¼ inches of its length, the cutter is throwing out chips 5/16 inch thick. Only a machine with capacity greater than the tools it drives could handle this job successfully—of course, "It's a Baker."

The Sterling Motor Company manufactures many of these parts, and requires the holes to be absolutely parallel and at exactly right angles to the center of the rod. For this reason, Baker Drills are the choice. They can be depended on to maintain accurate alignments when driving high-speed tools to capacity.



Baker Drills are always popular where the drive is hardest. Let us tell you the reason.

BAKER BROTHERS

TOLEDO OHIO, U. S. A.

Sterling

HACK SAW BLADES



They Wear Well

Blades that wear well—made from finest grade rolled high-tungsten alloy steel—by special machines and processes—the product of twenty years of specialization—blades of real merit.

Diamond Saw & Stamping Works

357-361 Seventh Street
BUFFALO N. Y.

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SELLING MACHINERY SERVICE



YOUROVETA
HOME & FOREIGN TRADE COMPANY

INCORPORATED

MAIN OFFICE—NEW YORK, 120 BROADWAY

BRANCHES:

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Operating through Associated Companies in:

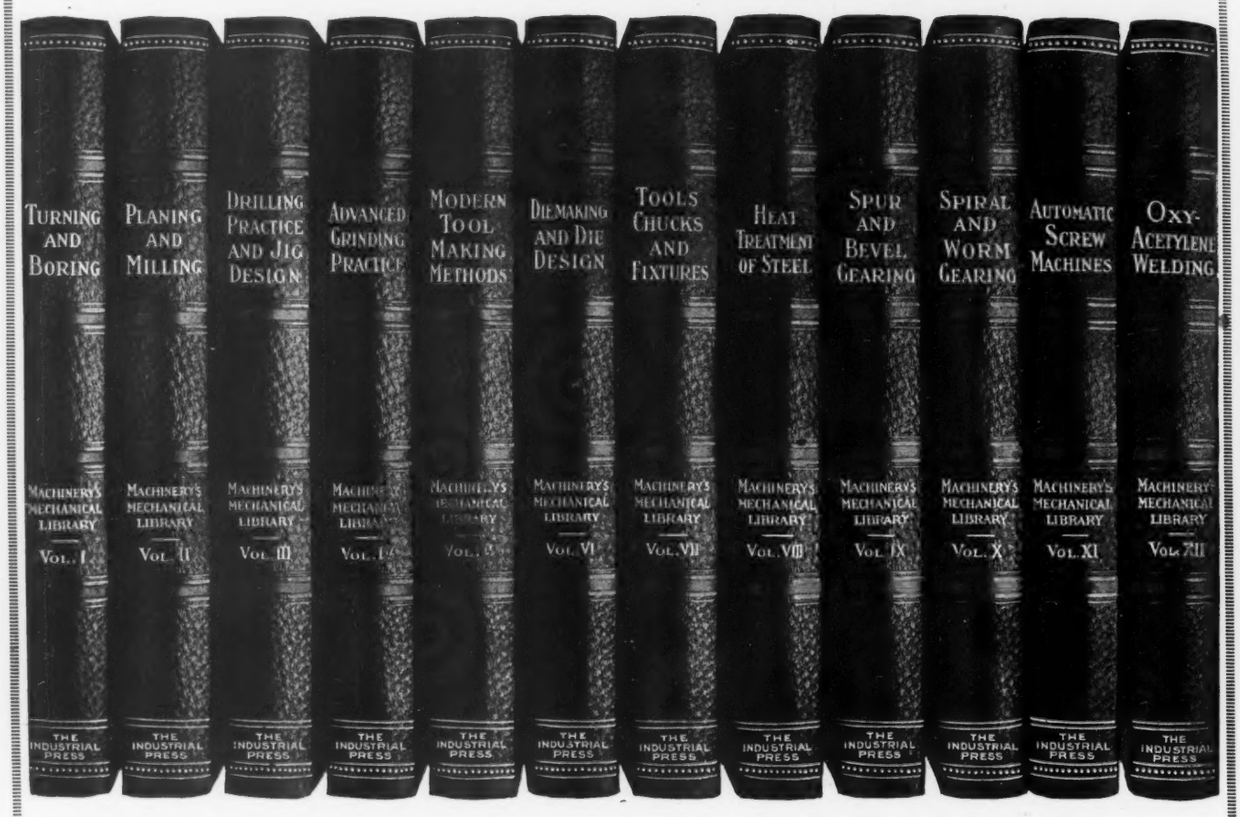
SOUTH AMERICA, ITALY, SCANDINAVIA, INDIA, RUSSIA

Has opened a Machine Tool Department to specialize in the distribution of American Metal and Wood Working Machinery and small tools in Russia and the Far East, under the direct management of A. M. Peskine, M. E.

This concern has been organized and in active business for more than ten years, is thoroughly acquainted with European and Far Eastern methods of salesmanship and is known among the large manufacturers of Europe and the Far East.

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They are clearly written books on machine shop practice and the design of tools, chucks and fixtures. They give a thorough basis of knowledge of the important branches of the machine shop and drafting room. Every clever and ambitious mechanical man needs just such authoritative books to train him to solve the problems he is up against today.

Never before was the mechanical man—trained, practical, resourceful—in such demand—or at such wages.

These twelve books give you the best practical training you can obtain in the operation of the standard machine tools, special processes such as heat-treatment of steel, oxy-acetylene welding, the practical design of gearings, tool making, chucks and fixtures—and every subject is treated in clearcut English. Each volume is well illustrated to make every method and process easily understood.

The binding is of fine waterproof fabrikoid. The books are each about 200 pages and you can still obtain this splendid library of over 2400 pages for yourself and your study for less than 7 cents a day.

Examine these books in your own home. We shall be glad to send them to you for ten days—FREE.—Simply fill out the coupon below—the books go to you the same day your order is received.

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MACHINERY, 140-148 Lafayette Street, New York.

You may send me, all delivery charges prepaid, MACHINERY'S Mechanical Library, twelve volumes, bound in durable, red fabrikoid, price $23.50. After inspection, I will decide to keep the books on terms of $3.50 in ten days and $2.00 monthly thereafter for ten months, or $22.00 cash 30 days—or I will return the books at your expense.

(Delivery charges prepaid in United States and Canada. Foreign orders, F.O.B. steamer. Foreign orders should be accompanied by full cash price—$22.00).

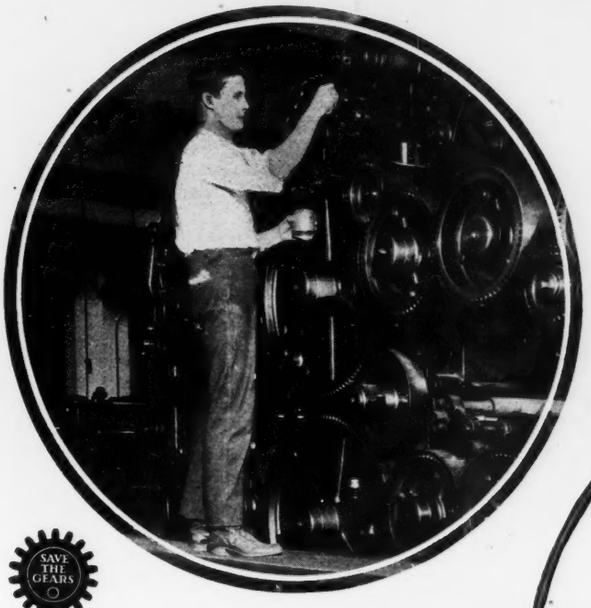
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Address.....Occupation.....

City.....Works.....

TEXACO

TEXACO
CRATER
COMPOUND



SAVE THE GEARS

Lubricates—Protects —Silences

"Most satisfactory for its lubricating and noise muffling qualities. Does not run off gears."—The McClure Newspaper Syndicate.

A different signature, but the same story. Texaco Crater Compound lubricates, protects, and silences gears wherever it is used.

"Crater on Gears" is a booklet that should be read wherever machinery is used. It's yours for the asking.

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Texaco Crater Compound is a *straight* product, pure, heavy, *free of all fillers.* It will not separate, harden, dry, crack, flake off, throw, run or drip—even under most abnormal conditions.

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"There's a Texaco Lubricant for Every Purpose."

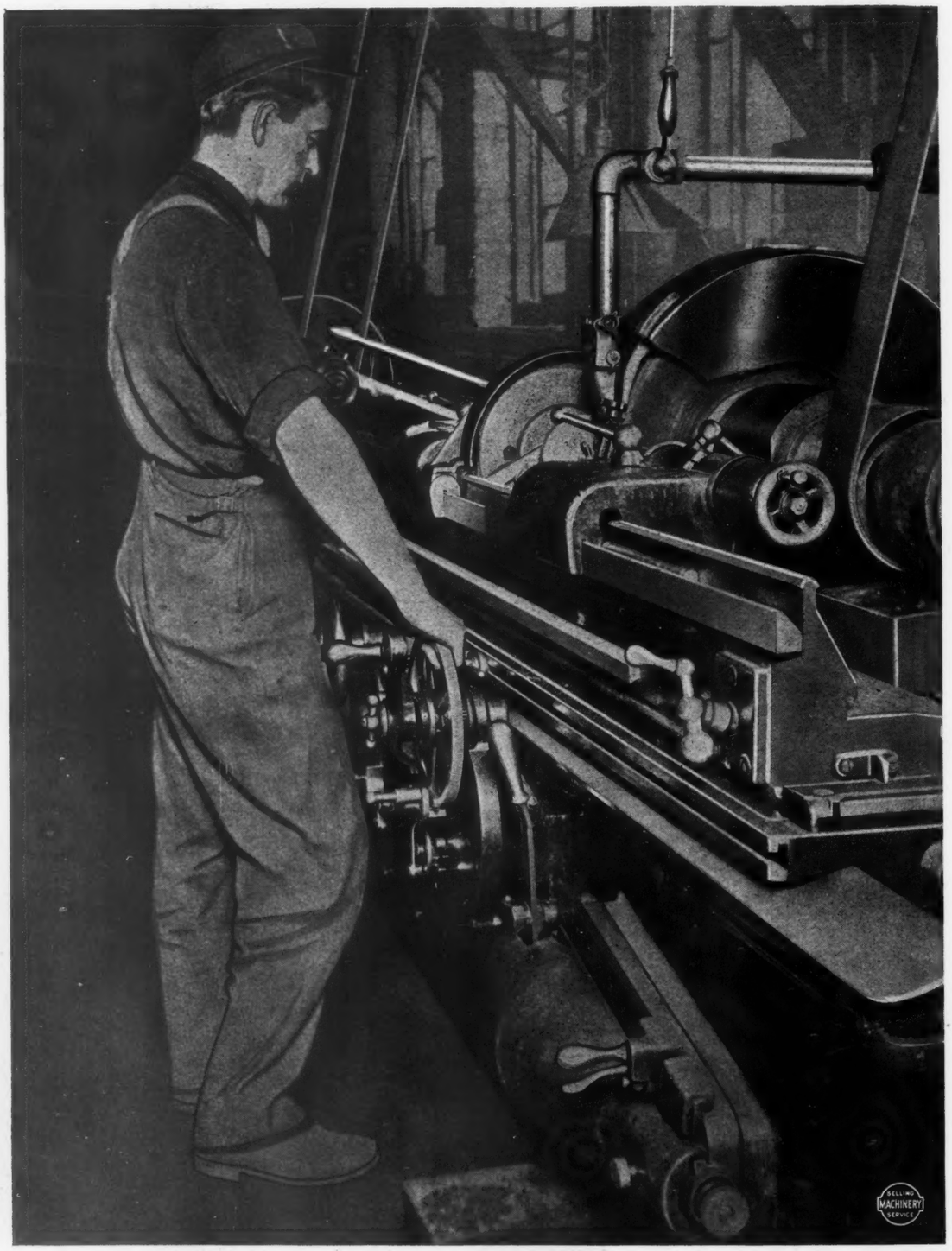
THE TEXAS COMPANY

Department F

17 Battery Place, NEW YORK

HOUSTON CHICAGO NEW YORK
Offices in Principal Cities

TO NORTON GRIND



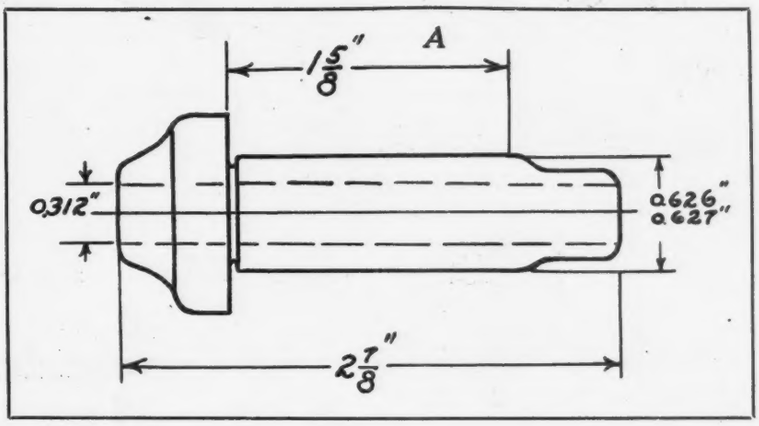
NORTON GRINDING COMPANY,

CHICAGO OFFICE:

AGENTS: Vonnegut Machinery Co., Indianapolis, Ind. Robinson, Cary & Sands Co., St. Paul, Minn., Duluth, Minn. Manning, Maxwell & Moore, Inc., St. Louis, Mo. Henry Prentiss & Co., Inc., New York, N. Y., Boston, Mass., Buffalo, N. Y., Rochester, N. Y., Syracuse, N. Y., Scranton, Pa. The Motch & Merryweather Machinery Co., Cleveland, O., Detroit, Mich., Pittsburgh, Pa., Cincinnati, O. Eccles & Smith Co., San Francisco, Cal., Los Angeles, Cal., Portland, Ore. The Canadian Fairbanks-Morse Co., Montreal, Que., Toronto, Ont., Vancouver, B. C.

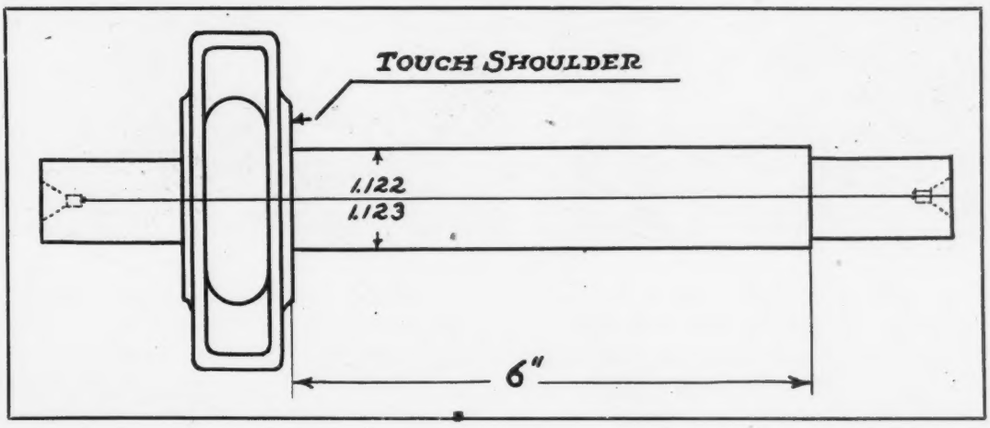
ING MACHINE USERS

Additional Examples of Up-to-Date Profitable Grinding



Our first example is a cast iron valve guide that is ground (diameter A) on an arbor. 0.020 stock is removed. The machine is a 6″ x 32″ Norton Grinding Machine. The wheel is a 14″ x 2″ x 5″ 36 N "Crystolon." Output is 900 pieces in 10 hours.

Our second is a steering gear shaft; .45 carbon steel; 0.035″ stock removed; limit 0.001″. The machine is a 10″ x 24″ Special Purpose "Norton" fitted with a 20″ x 6½″ x 12½″ 3824 Alundum L wheel. Production on this job is 1000 pieces in 9½ hours.



If your Norton Machines are being operated to full efficiency we're satisfied; if not we would suggest that you ask for a Norton demonstrator. We want every Norton Grinding Machine to do its utmost—now and always; but particularly now.

Our Service Department is at your disposal.

Worcester, Massachusetts, U. S. A.

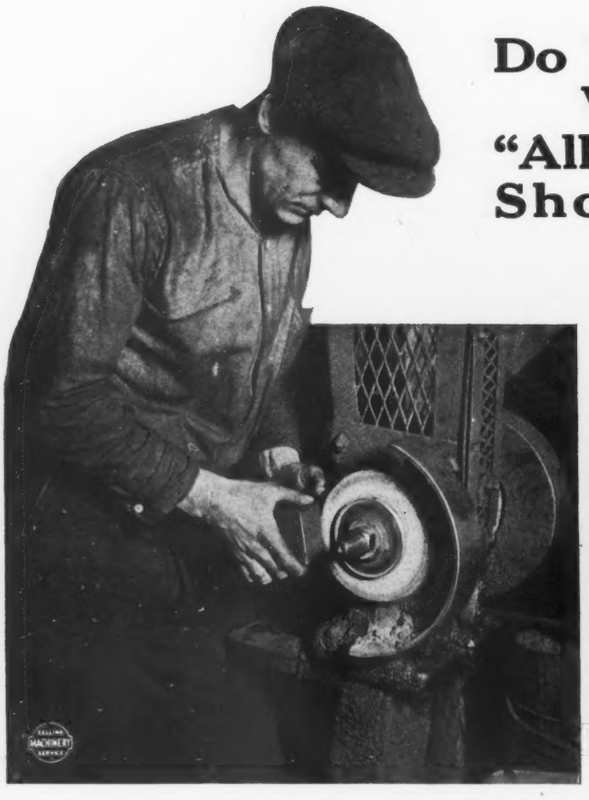
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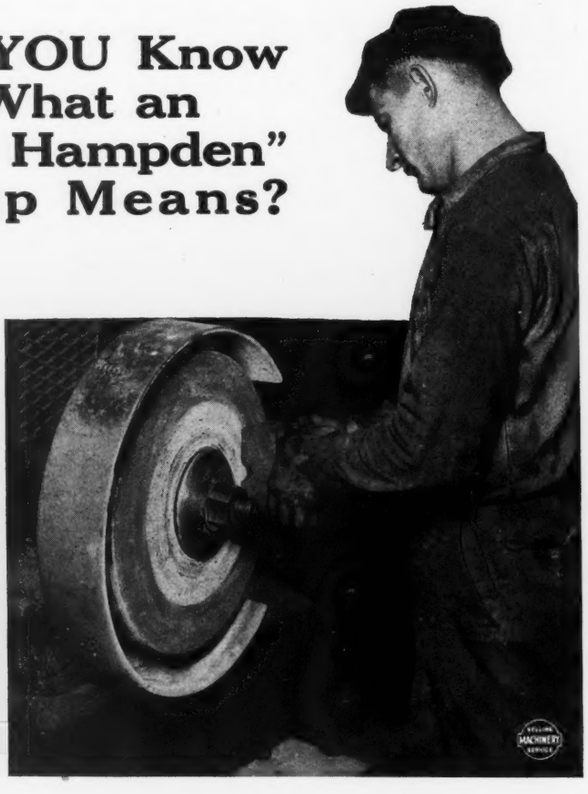
C. T. Patterson Co., Ltd., New Orleans, La. Kemp Machinery Co., Baltimore, Md. W. E. Shipley Machinery Co., Philadelphia, Pa. English Tool and Supply Co., Kansas City, Mo. Alfred Herbert, Ltd., Coventry, Eng., Paris, France, Milan, Italy. The F. W. Horne Company, Tokio, Japan. Iznoeskoff & Company, Petrograd, Moscow and Ekaterinburg, Russia.

N-206

Hampden Corundum Wheels

Do YOU Know What an "All Hampden" Shop Means?





Here are two of sixteen busy Hampden Corundum Wheels employed in a busy "All Hampden" shop. By the way, an "All Hampden" shop is one in which only Hampden Corundum Wheels are used.

The operators are grinding forging machine dies of heat-resisting steel, as hard a metal as can be made. The smaller wheel is cleaning out grooves or "fluting" the dies; the larger one is dressing off the flat faces.

There's little consideration shown the wheel when these heavy chunks of hard steel are jammed up to it. Hampden Corundum Wheels show up here as strongly as they invariably will under more favorable conditions.

We want you to put Hampden Corundum Wheels to a test. You'll like them.

We will be glad to help on your grinding problems in whatever way we may. Write us.

Hampden Corundum Wheel Co.

Springfield, Mass., U. S. A.

Some System Here—

and the Important Part of it is the

Gardner Grinder



The No. 7½ Gardner Grinder shown is used by the Bronze Metal Company of Bristol, Pa., for grinding bronze castings of all kinds and degrees of hardness. It has been photographed at its principal occupation, preparing bushings and bearings for subsequent turning operations.

This machine handles two of these parts at a time, first surfacing what becomes the longitudinal axis of the finished cylinder and then squaring the ends. "Gardner-grinding" brings the rough faces to substantially level surfaces, removing 1/32" or more of stock. Fifteen to eighteen pairs—60 to 70 surfaces—are "Gardnerground" per hour, keeping two turret lathes well supplied.

You'll do well to make "Gardnergrinding" a part of *your* system. We'll be glad to send you full details as to its application to your work. Write us.

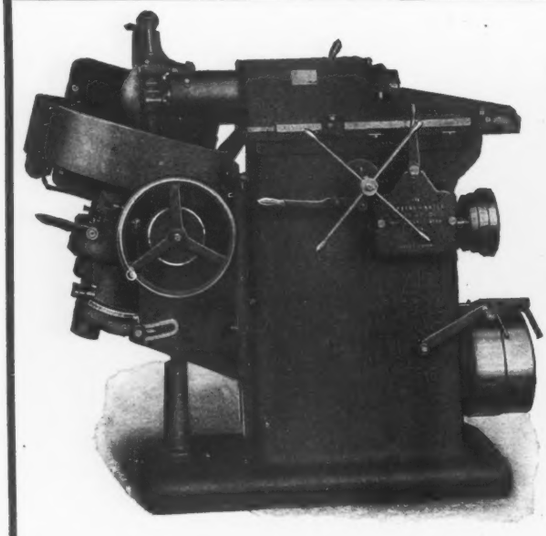
The Gardner Machine Company

BELOIT THE LARGEST MANUFACTURERS OF DISC GRINDERS IN THE WORLD **WISCONSIN**

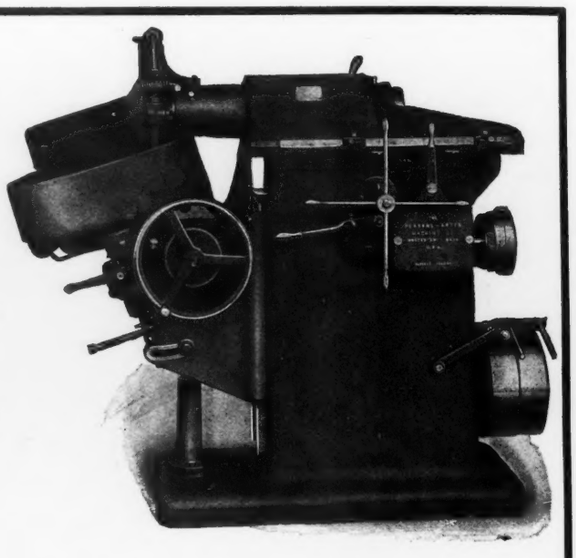
OVER-SEAS REPRESENTATIVE

ALMACOA ALLIED MACHINERY COMPANY OF AMERICA ALMACOA
120 BROADWAY, NEW YORK, U.S.A.

PARIS TURIN ZURICH BARCELONA



Work Table Can Be Tilted 16½° Either Way

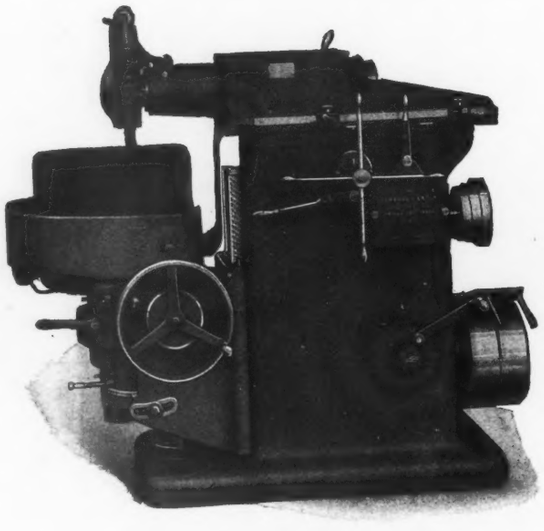


A New Model 16-Inch Rotary Surface Grinder

Insistent demands from satisfied users of our 8″ and 12″ sizes of grinders, for a machine with even greater capacity have led us to design a 16″ machine. Hand and automatic feeds, friction clutches, perfectly maintained adjustments of work table and slides, wide range and a superior magnetic chuck of our own design, are contributing features to the success of these machines. For all classes of surface grinding, engineers now specify a

PERSONS-ARTER

The work table at its lowest position allows the grinding of work 10″ thick under a full diameter wheel.

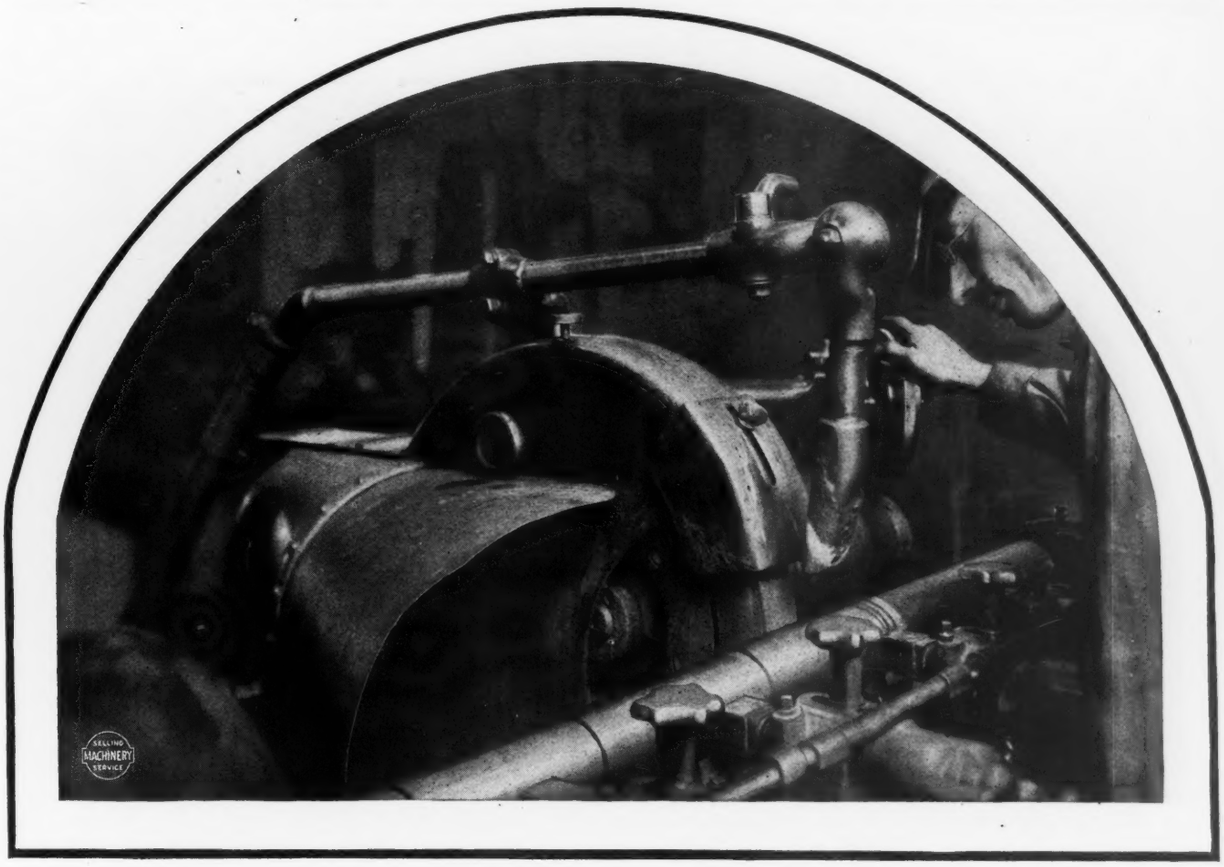


Within range Persons - Arter machines can handle much of the work usually given to rectangular types of grinders.

Let us show you what Persons-Arters can do for you

THE PERSONS-ARTER MACHINE COMPANY

72 Commercial Street **Worcester, Mass.**



An Abrasive Boro-Carbone Wheel That Has Made A Record

Boro-Carbone
TRADE MARK
for high tensile materials.

Electrolon
TRADE MARK
Silicon Carbide
wheels for low tensile materials.

ABRASIVE CO.

Main Office and Works
Bridesburg, Philadelphia

Chicago Store
566 West Washington Boulevard

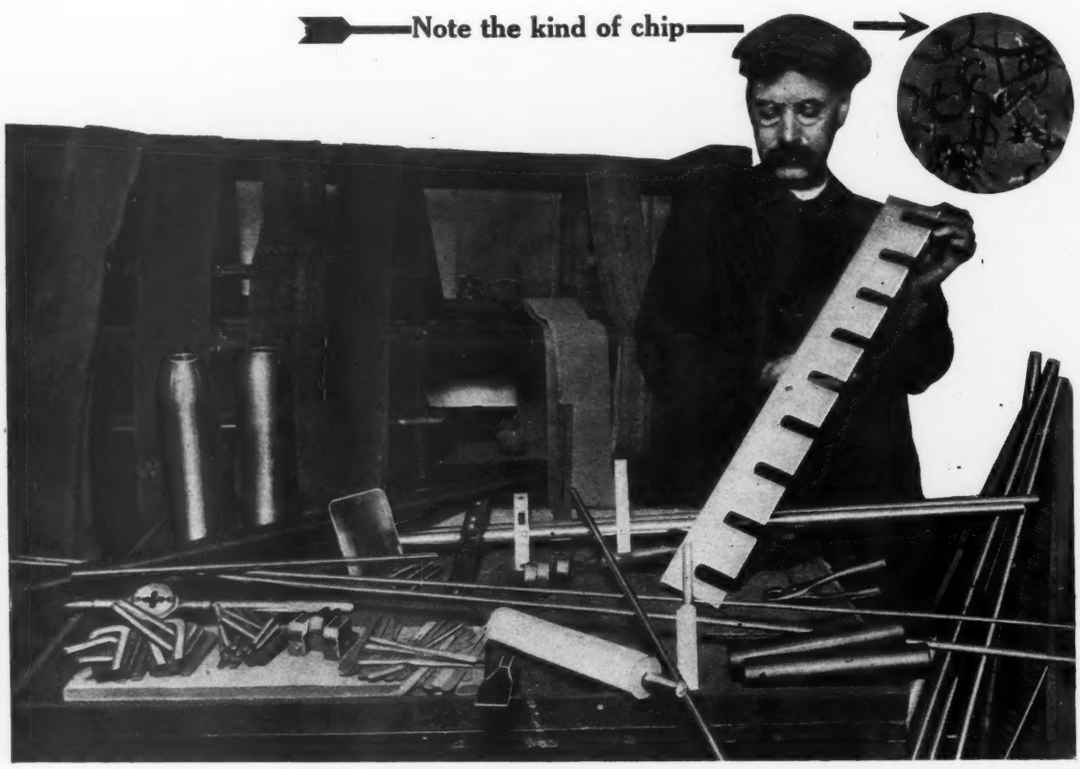
"ABRASIVE" BORO-CARBONE WHEELS

THIS is not a production story. It has a more distinctive theme—inspection. Every shaft ground by this wheel is inspected and re-inspected and, despite the fact that limits are .001 and the stock 60 point carbon steel forgings, never fails to come through with flying colors.

The wheel with this 100 per cent efficiency record is Comb. 24 Grade L Boro-Carbone, 18 inches diameter, 2 inch face. The shafts—parts for centrifugal pumps—are 41½ inches long and 2⅜ inches diameter, excepting for a distance of 8¾ inches near the center, where the diameter is 2¾ inches.

This work must pass a rigid government inspection and great care was used to secure the right wheel. Boro-Carbone fully justified the choice.

Boro-Carbone can always be depended on. It is only a case of fitting the wheel to the work and on this point we are always ready to cooperate—write us *your* requirements.

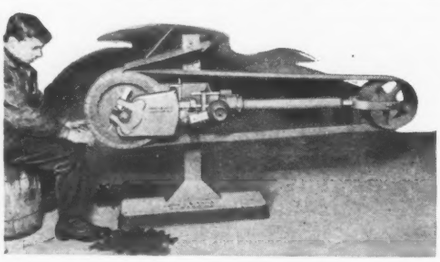


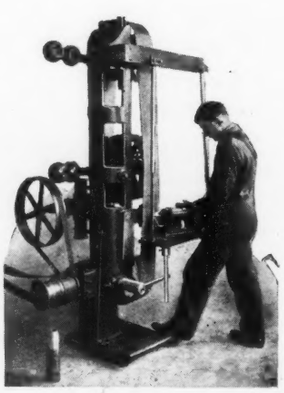
Your Attention is Called to the Variety of "Blevney" Output

IN GRINDING, POLISHING AND FINISHING

There are twenty-five kinds of work on the table in the above photograph—shells, steel and fibre tubing, planer knives, door locks, rubber wringer rolls, pliers, precision measuring scales, taps, dies and wrench parts, trench mirrors, etc.—all products of Blevney Cushion Belt Grinders.

Below are shown the two styles of Blevney Grinders—types A and B. These machines will speed up your grinding and finishing. The cutting principle is the same in both machines. The abrasive belts run over corrugated cushion belts, which form teeth in the former. Ample chip clearance and consequent clean, sharp grinding are thus assured.





Send for further details of the Blevney System. They are bound to interest you

BLEVNEY MACHINE COMPANY

GREENFIELD, MASS., U. S. A.

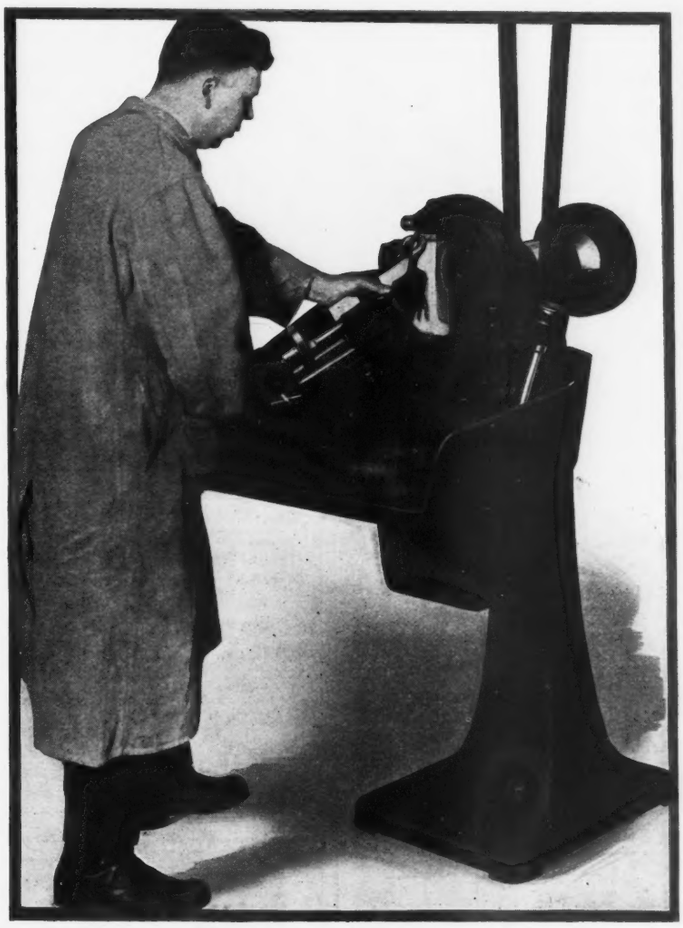
OVER-SEAS REPRESENTATIVE

ALMACOA ALLIED MACHINERY COMPANY OF AMERICA ALMACOA

120 BROADWAY, NEW YORK, U.S.A.

Grand Rapids Drill Grinders Are Different

They embody new principles of construction and operation. They grind drills correctly—both theoretically and practically. They grind perfectly faster than you can grind "good enough" by hand. They are practically "fool proof." A boy or girl can run one. They embody degrees of refinement in design, workmanship and material never before attempted in this class of machines. They will not only start right but they will stay in service.



The Grand Rapids Drill Grinder Book tells all about them and a lot about Twist Drills too. Tell us where to mail your copy.

Grand Rapids Grinding Machine Co.

29 Ottawa Avenue, N. W. GRAND RAPIDS, MICH., U.S.A.



We cannot make all the Grinding Wheels used, so we make the BEST.

Try "THE WHEEL THAT TALKS FOR ITSELF"

Manufactured by

NATIONAL GRINDING WHEEL COMPANY, INC.

2986 MAIN ST. BUFFALO, N. Y.

NATIONAL GRINDING WHEEL COMPANY INC.

The H. P. No. 1 Truer

For Precision Grinding Wheels

The H. P. No. 1 Truer and Dresser is an unusually efficient tool for truing precision wheels used on rough and semi-finish grinding operations. It may be used for wet or dry dressing, is dust and water proof and has forced lubrication. Cutter guaranteed for 1000 dressings. All shanks interchangeable. Safety guards protect operator from possible breakage of cutters and from emery particles.



10 Days' Free Trial

Send for complete details

THE H. P. COMPANY
45-47 EAST FORT ST.
DETROIT, MICH.

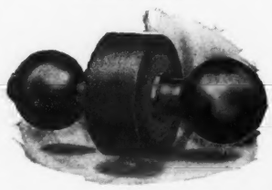
METCALF EMERY WHEEL DRESSER

"IT'S A WONDER"

Indispensable for grinding wheels 12 x 1 inch or smaller, turning perfect square, bevel or V edges

FINE FOR
Machine Shops
Tool Rooms
Filing Rooms
Metal Parts
Motors
Engines
Crank and Cam Shafts
Etc.

60,000 SOLD



FINE FOR
Fire Arms
Munitions
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Screws
Brass Goods
Woodworkers
Steel Mills
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Ship Yards
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$4.50 NET FACTORY

4-page descriptive circular on request

Plant operators order from 1 to 60 at a time

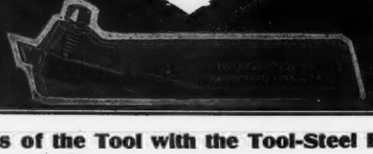
BALDWIN, TUTHILL & BOLTON, Sole Makers

GRAND RAPIDS Orders for domestic and export shipment invited MICHIGAN, U.S.A.

RED-E TOOLS

Send for Catalog of our full line. It will pay you.

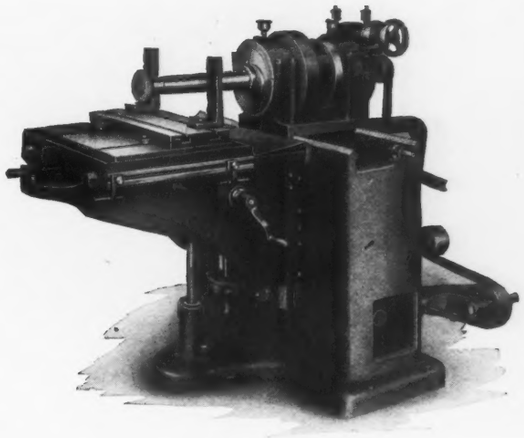
THE READY TOOL COMPANY
650 Railroad Ave.
Bridgeport
Ct.



Makers of the Tool with the Tool-Steel Bearing

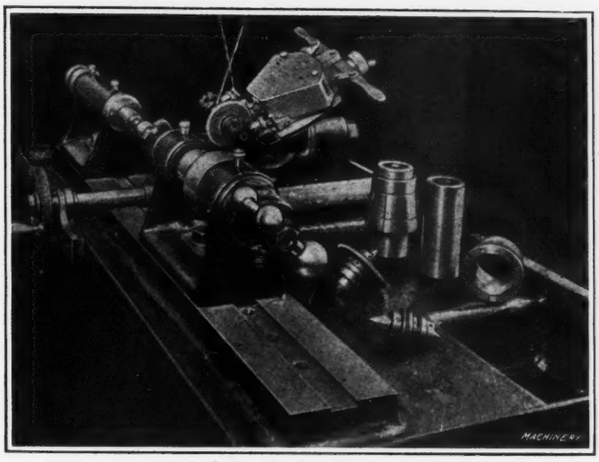
MADISON CYLINDER GRINDER

A simple, rigidly constructed cylinder grinding machine particularly adapted to a wide range of work.



Write for Particulars.

MADISON MACHINE TOOL COMPANY
FORMERLY E. A. FULLER SALES COMPANY
609 East Washington Avenue Madison, Wisconsin



The New COMMUNITY Thread-Gage Grinding Machine

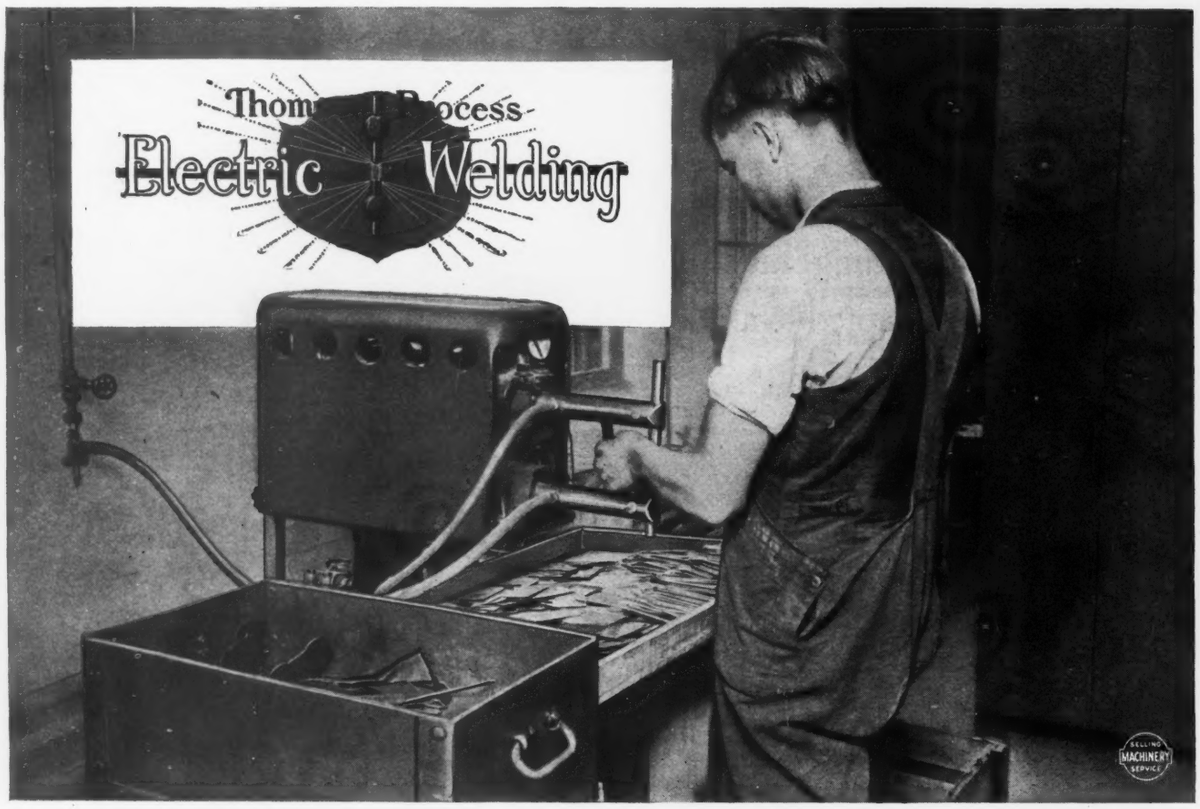
The photograph shows end view of Community Thread-Gage Grinding Machine, showing Graduated Swivel to adjust for Helix Angle.

THE United States Army Ordnance Department gage checker's report on the Edison Company's thread-gages used on 240 mm. trench mortar shells reads—"Gages accepted. Leads and angles checked and found O.K." The British Ministry of War Inspection Laboratories have also checked and reported favorably on thread-gages made for the United States Army Signal Corps and ground on the Community Thread-Gage Grinding Machine.

For quantitative production of thread-gages the Community Thread-Gage Grinding Machine has set a new standard. For instance, male thread gages 1/8 to 1/2 inches in diameter are ground in 10½ minutes to 1 inch diameter at an average of twenty minutes each. The gages ground on the Community Thread-Gage Grinding Machine are accurate to within 0.0001 inch for the lead and five minutes for the angle.

Send for further details without delay.

Community Machine & Tool Works
INCORPORATED
154-156 Grand St. New York City



THOMSON SPOT WELDING

Welding Garden Hoes for the "Kiddies" is Thirty-three and One-third Per Cent Cheaper than Riveting—and Stronger

This Thomson Spot Welder is a recent installation, so the operator is not yet sufficiently experienced to make the most of its possibilities, but already the cost of welding these children's garden hoes has dropped 33 1/3 per cent in this New England plant. Two "spots" secure the blade to the shank and without pushing himself very hard, the operator completes 1000 hoes, or 2000 welds, per hour. When he gets the hang of the machine he will do even better.

The old way was to rivet drilled holes and not only the output but results have improved by the change—especially from the "kiddies" point of view—for rivets frequently work loose, when put to the test of "real gardening" and the spot welded hoe can be depended on for a full term of service.

Thomson Spot Welding has been applied to assembling all kinds of hardware specialties and hundreds of other operations.

We are opening new fields every day and will be glad to prove its cost cutting application to your work.

THOMSON SPOT WELDER CO.
LYNN.

84 State St., Boston — 30 E. 42nd St. New York City — 603 Finance Bldg. Phila.



Thomson Process
Electric Welding

THOMSON ELECTRIC WELDING

Two Welding Machines Keep Five Men Busy Assembling

The work being handled in this busy corner of a wire goods shop is wire guards such as are used to protect electric light bulbs. This is one of the operations where assembling is done on a form, indexed automatically for welding. In this case, one operator makes eleven welds; the form is then transferred to a second man, whose machine is set for a closer working distance, and he also makes eleven welds. Both operators work so fast that they keep five men busy assembling—production running as high as 4840 welds or 220 lamp guards per hour.

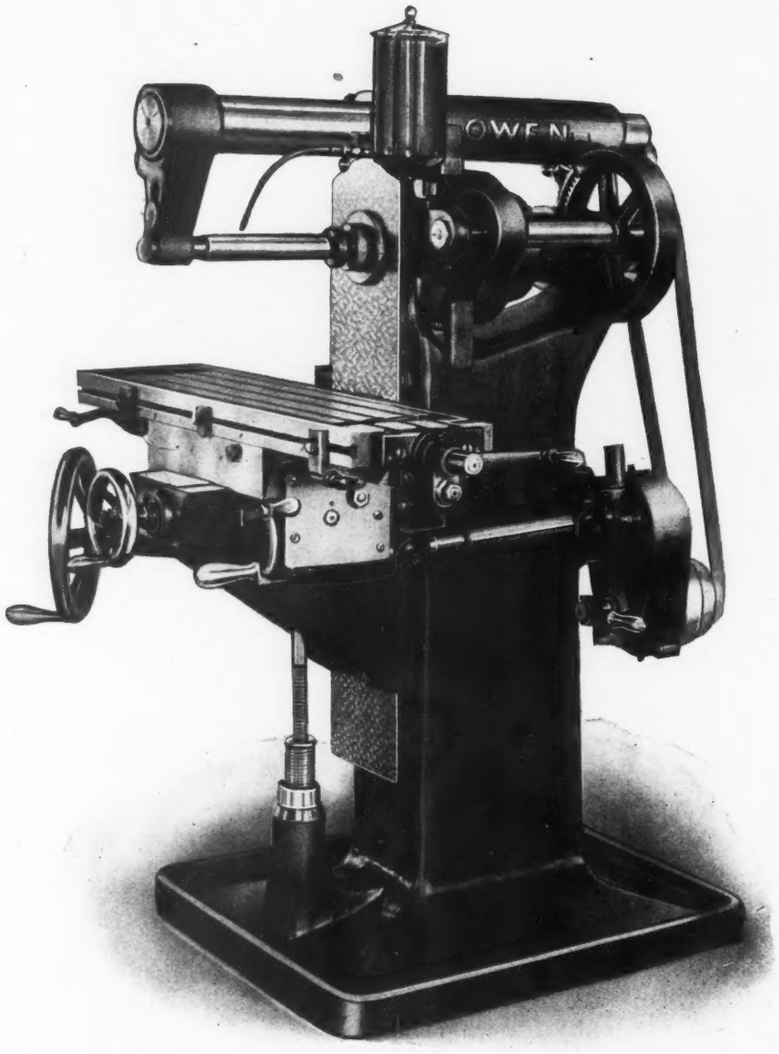
There are 14 Thomson Welders, all told, in this plant—eight years in use and their speed records still the boast of the shop. Thomson Electric Welding Machines are built in types and sizes to handle a constantly broadening range of work. In every case, welding proves fully as strong—in some instances stronger—than the methods it replaces, as well as faster and more economical.

May we estimate on your requirements ?

THOMSON ELECTRIC WELDING CO.
MASS., U.S.A.
311 Falls St., Niagara Falls — 4100 Langdon St. Cincinnati, O. — 1127 Majestic Bldg., Detroit — 323 N. Sheldon St., Chicago, Ill.

OWEN

No. 0 PLAIN BACK-GEARED MILLING MACHINES



The Owen No. 0 Plain Back-geared Milling Machine is a strong, rigid tool with great pulling capacity. It has 12 spindle speeds and provides 8 changes of feed for each. Spindle is of crucible steel, has 13/16″ hole through it, and runs in phosphor bronze boxes. Spindle and boxes are both made to compensate for wear. Table is automatically fed in either direction, automatic stop releases the work where desired, adjustable dials indicate in thousandths the three table movements. Range 24″ longitudinal, 6″ cross, 15″ vertical. Power longitudinal feed.

BICKETT MACHINE & MFG. CO., Cincinnati, Ohio

New York Selling Agents

YOUNG, CORLEY & DOLAN, Inc., 115 Broadway, New York City



A Simple Matter of Dollars and Cents

The work is pistons for Franklin engines, straight and taper sections to be finish turned—the straight section to 3.250″ diameter, plus or minus 0.001″. These pistons are of Lynite, rough turned on a big automatic with about 1/32 inch left on the diameter for finishing, for which operation they are transferred to a Porter-Cable Manufacturing Lathe.

Why? To save money. The Porter-Cable Lathe is pre-eminently a second operation machine, designed for speed in close limit operations. The Franklin people, in company with many other prominent manufacturers, find it far more economical to keep their big, expensive automatics on the heavy end of turning operations and put the fine finishing up to the "Porter-Cable" which gives a smoother finish and practically eliminates hand work in fitting. There is nothing technical or obscure about it—just a simple matter of dollars and cents.

On this particular job, the work is supported at one end on a center and at the other by a special holder which also drives it.

There are six Porter-Cables in the Franklin installation, all in constant demand. Catalog gives all the details.

THE PORTER-CABLE MACHINE COMPANY

SYRACUSE **NEW YORK, U. S. A.**

EXPORT REPRESENTATIVE: Benjamin Whittaker, 2 Norfolk St., Strand, W. C., London

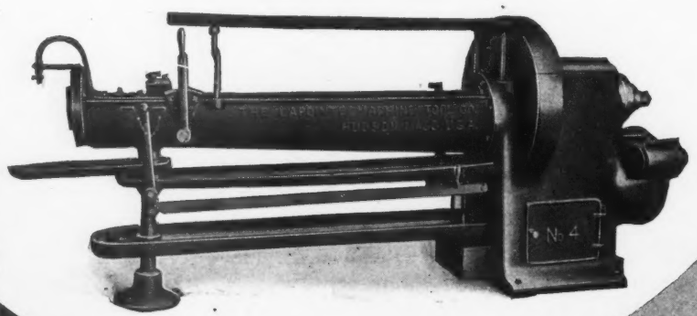
Increase Your Broaching Profits

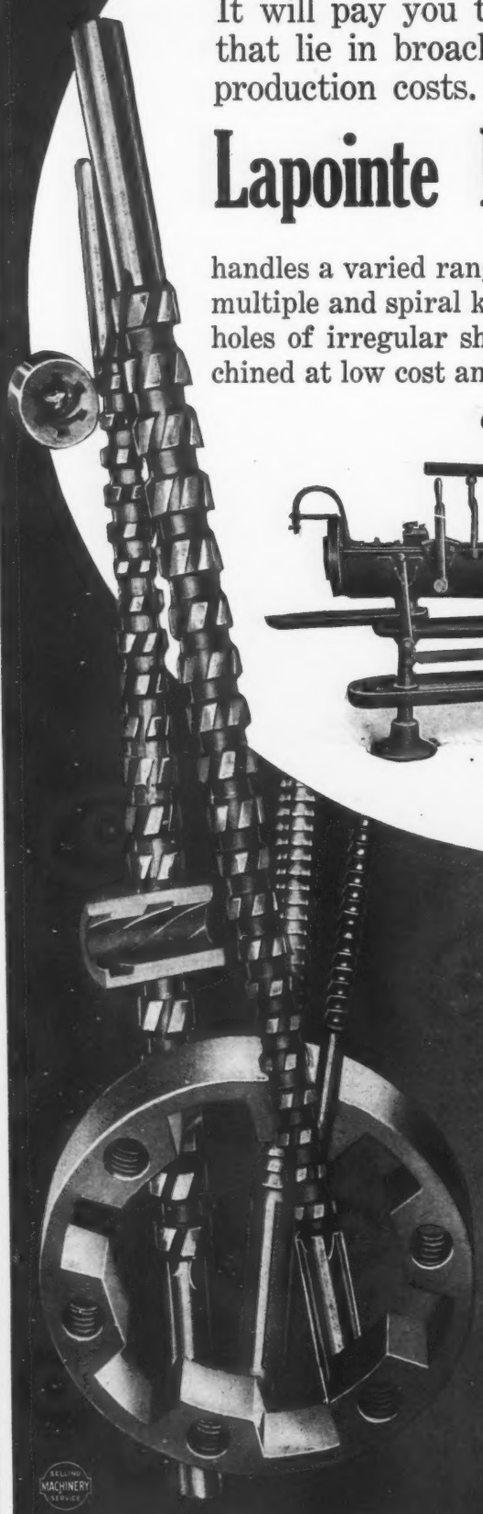
It will pay you to investigate the possibilities that lie in broaching—and so reduce present production costs.

Lapointe Broaching Machine

handles a varied range of work satisfactorily. Square holes, multiple and spiral keyways, highly finished round holes and holes of irregular shape can be rapidly and accurately machined at low cost and by unskilled operators.

Catalog gives details.





THE LAPOINTE MACHINE TOOL COMPANY

Hudson, MASS., U.S.A.

DOMESTIC AGENTS: Motch & Merryweather Machinery Co., Cleveland, Detroit, Cincinnati, Pittsburgh. Henry Prentiss & Co., Inc., Buffalo, Syracuse, Rochester, New York and Boston. W. E. Shipley Machinery Co., Philadelphia, Pa. Vonnegut Machinery Co., Indianapolis, Ind. Hill, Clarke & Co., Inc., Chicago, Ill. Aumen Mchy. Co., Baltimore, Md. FOREIGN AGENTS. Alfred Herbert, Ltd., Paris, France. Burton, Griffiths & Co., Ltd., London, England. V. Lowener Co., Christiania, Norway. Stokvis & Fils, Brussels, Belgium. Alfred Herbert, Ltd., Yokohama, Japan. Chas. Civita, Milano, Italy. Barandiaran Y Metivier, San Sebastian, Spain.

THE NATIONAL MACHINERY CO. TIFFIN, OHIO, U.S.A.

Save Stock and Machining on Your Gear Blanks



In Making Such Forgings on the

NATIONAL

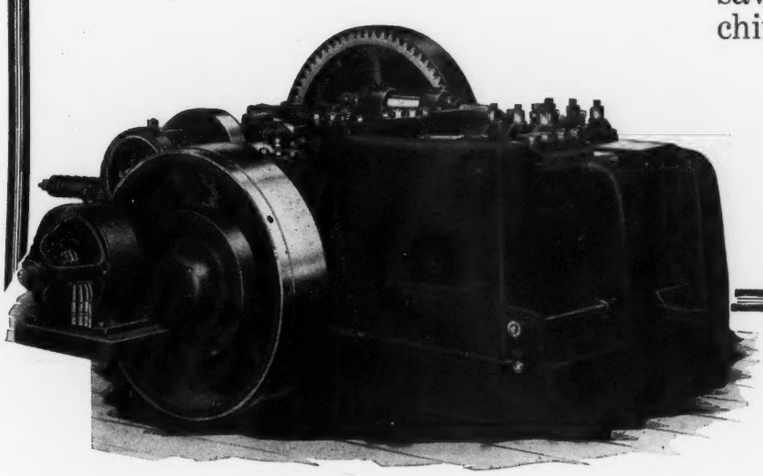
Heavy-Pattern Forging Machine

(All Steel)

you eliminate the flash, excessive draft and the tong-hold necessary when producing such parts under the hammer.

Generally such parts are alloy steel, which is expensive and tough to machine, and if made on the Automatic or Turret Lathe the cost is high.

The National method of upsetting such gear blanks is the economical way, because with National construction—long "suspended" type slides and provisions for maintaining alignment—you can work to close dimensions, effecting big saving in stock and machining.



Are you receiving National Forging Machine Talks?

The National Machinery Co.

TIFFIN, OHIO, U. S. A.

After the War, What?

Six thousand (more or less) writers, authors, politicians, men of big business, bankers and taxi-cab drivers have undertaken to tell us what is going to happen after the war. And one man's guess is as good as another's.

Our guess is that the world will continue to make one complete revolution every twenty-four hours, as per usual—and that we will all continue to eat and wear clothes and do just about as we always have done.

And businesses will grow or fail—and advertisers will advertise. We are of the opinion that some things will be done a little better than ever before and that advertising is one of them. We are laying plans right now to develop and better the advertising and marketing of mechanical products, especially machine tools and machine tool accessories.

Any man or concern in our field who wants help on his particular problems is invited to write us.

MACHINERY :: New York

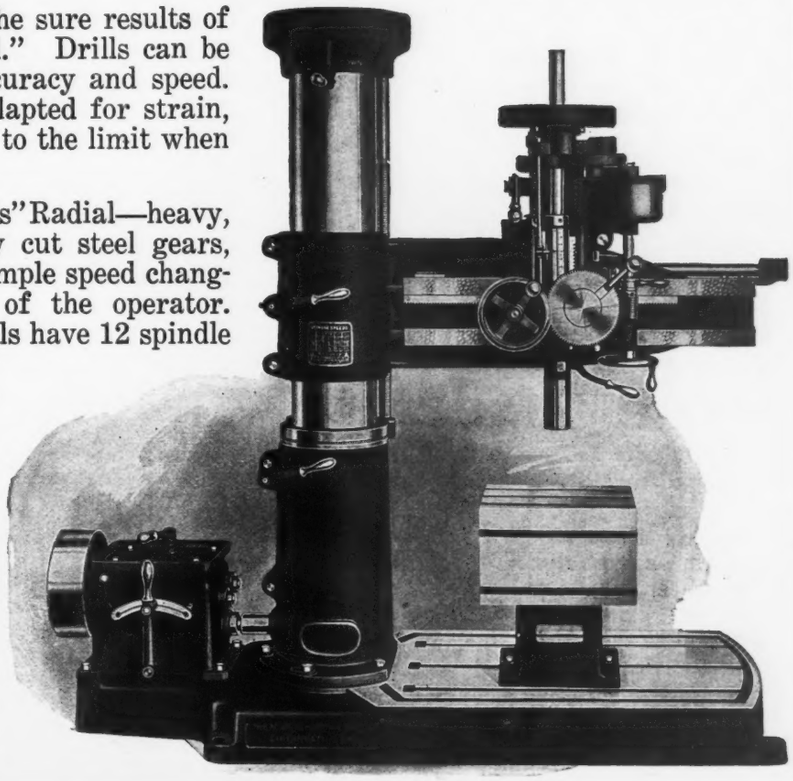


"MORRIS"—"Built for Results"

Production and profit are the sure results of installing a "Morris Radial." Drills can be driven to capacity with accuracy and speed. Sturdily built, rigid and adapted for strain, this machine can be pushed to the limit when necessary.

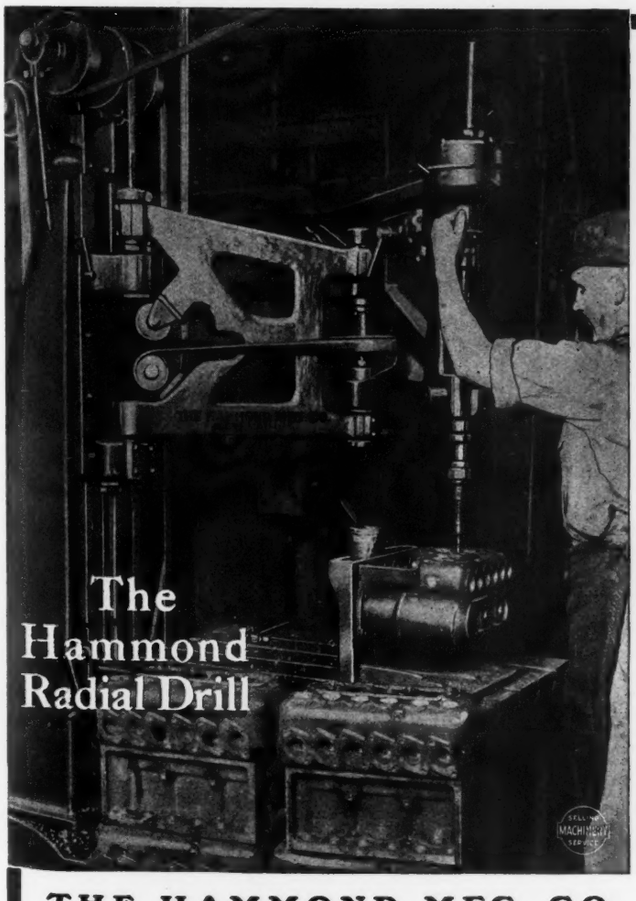
A few features of the "Morris" Radial—heavy, semi-steel column, correctly cut steel gears, double friction clutch and ample speed changes all within easy reach of the operator. The 2½, 3 and 3½ foot drills have 12 spindle speeds. The 4 and 4½ foot drills have 18 spindle speeds.

Ask for Catalogue.



The
MORRIS MACHINE TOOL COMPANY
CINCINNATI, OHIO, U.S.A.

REPRESENTATIVES: Niles-Bement-Pond Company, 111 Broadway, New York City, N. Y., Boston, Mass., Chicago, Ill., Detroit, Mich., Philadelphia, Pa., Pittsburgh, Pa., Plainfield, N. J., St. Louis, Mo. Niles Tool Works Co., Cleveland, O., Hamilton, O., Pratt & Whitney Company, 16 Fremont St., San Francisco, Cal., Birmingham, Ala., Cincinnati, O. The John Bertram & Sons Co., 1002 C. P. R. Building, Toronto, Ontario, Montreal, Quebec, Dundas, Ontario, Winnipeg, Manitoba.



"Speeding Up"
with a
HAMMOND
HIGH-SPEED SENSITIVE
RADIAL DRILL

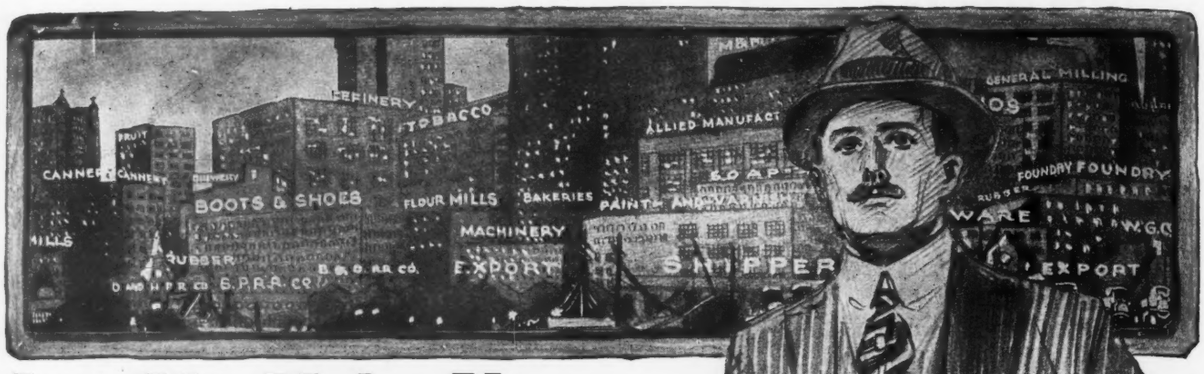
HERE is a Hammond radial drill operator who regularly taps 27 holes in 23 cast-iron cylinders per hour, a daily (9½ hours) output of 220 accurately tapped cylinders. And these holes are distributed over three sides of the casting: 24 are 5/16", 18 pitch; 3 are 3/8", 16 pitch.

Hammond Radials do cut costs—it has been demonstrated many times. No moving of heavy work for each hole. A single motion brings the drill over any part of the work. Drill radius, 48 inches. Belt or motor driven. Furnished in wall type if desired. Regularly equipped with three spindle speeds, 380 to 1000 r.p.m. Upon specification can be furnished with speeds of 750 to 2000 r.p.m. or 190 to 500 r.p.m.

Self-contained friction tapping attachment (furnished when ordered), capacity up to ½" standard taps, backs the tap out at a speed 50% higher than the cutting speed.

Write today and find out how a Hammond Radial will cut your drilling and tapping costs

THE HAMMOND MFG. CO.
386 Frankfort Ave. Cleveland, Ohio



Let Us Help You Serve Effectively

Service is vitally necessary in business today that we may pull together to accomplish our common aim.

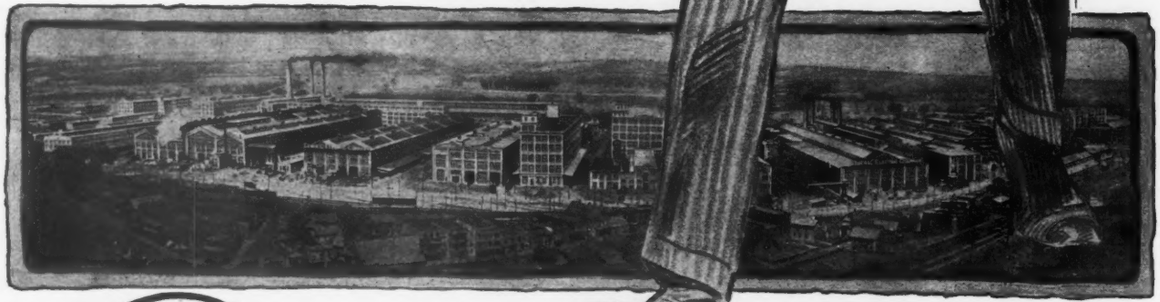
The General Electric Company has located industrial power experts at all large cities in this country to serve industry's electrical requirements. For instance, experienced textile mill electrical engineers will be found in all textile centers. Among other industries so served are the iron and steel, coal and metal mining, cement, clay and glass, lumber and woodworking, grain and sugar, canning, packing, and refrigeration, shoes and rubber, paper and wood pulp, tobacco and cigars, chemicals and gas, and the construction and shipbuilding.

These experts are prepared to co-operate with industrial engineering firms to show the best way to drive a machine or a factory to get maximum production of highest quality at minimum power cost.

Back of these experts is the experience gained in supplying much of the electric power equipment now used in American industry and a corps of scientists with research facilities for pioneer work.

Call on us to help perfect your service to American business.

43-43



GENERAL ELECTRIC COMPANY

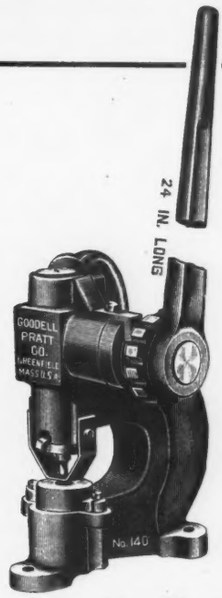
General Office, Schenectady, N. Y. Sales Offices in All Large Cities

GOODELL-PRATT
1500 GOOD TOOLS

Here are Two *Invaluable* Bench Tools



Bench Shear



Bench Punching Machine



These two tools are fully described on pages 270 and 271 of our Tool Book Number 13 — that's our latest edition. Keep *your* copy near you for quick reference to "the famous 1500."

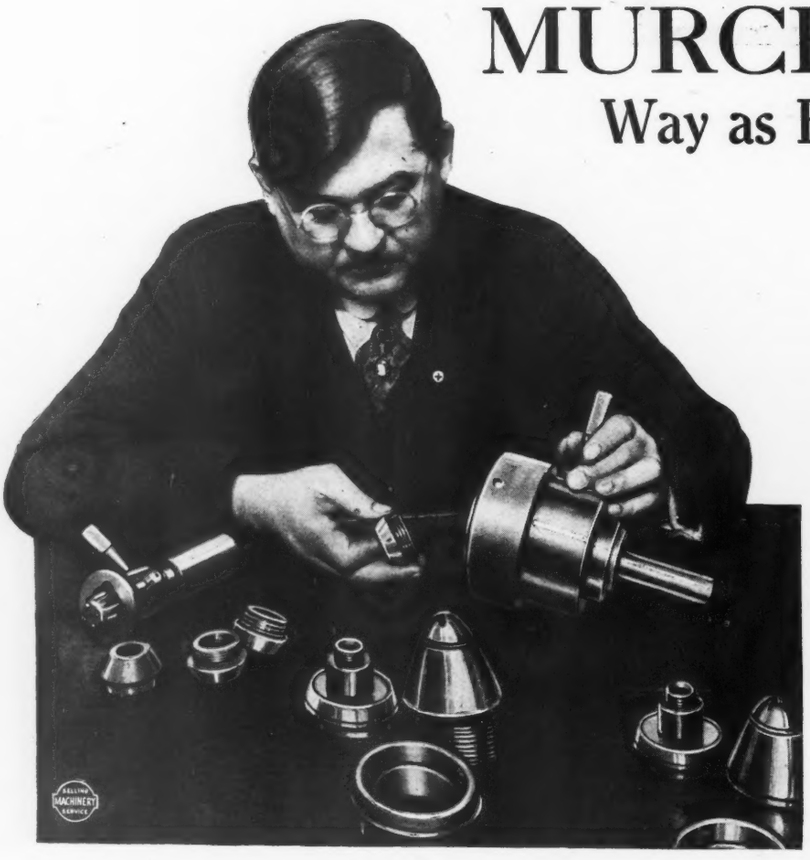
The Goodell-Pratt Bench Shear is a dandy little tool. The frame is so designed that sheets of any width may be readily cut. The lever is 20 inches long, and the tool steel blades have 4-inch cutting edges. All iron parts are finished in red and black enamel—steel parts are polished. Net weight 31 pounds.

The Goodell-Pratt Bench Punching Machine is an exceptionally powerful and clean cutting machine for punching holes in thin sheet iron or steel. It is provided with a 24-inch handle and a 3/8-inch round punch and die. It is well designed, and carefully made. Iron parts are finished in red and black enamel—steel parts are polished. Depth of throat 4 inches. Net weight 54 pounds.

GOODELL-PRATT COMPANY
GREENFIELD *Toolsmiths* **MASS., U. S. A.**

Several Ways to Do It

This Engineer Picks the MURCHEY Way as Best



Again the production engineer's solution of the job lies in Murchey Taps and Dies.

Shell Makers Ought to Know This

To be sure, there are several ways of threading the inside and outside of 75 m. m. high explosive adapters, but undoubtedly only one way is *best.* This production engineer has found that way via Murchey Taps and Dies. How many men discover this fact will depend on the number willing to try Murchey Taps and Dies on this class of work.

We solicit further enquiries.

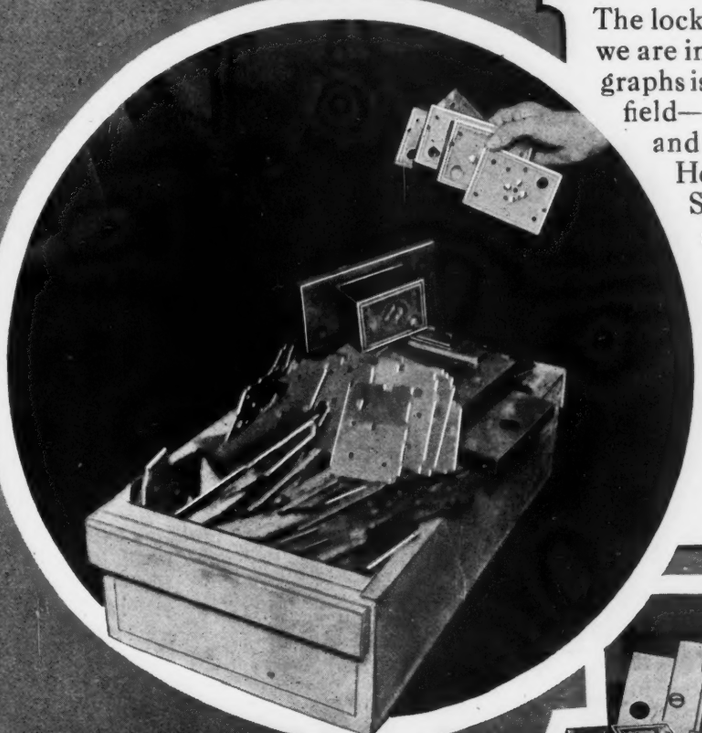
MURCHEY MACHINE & TOOL CO.

DETROIT (34 Porter Street) MICHIGAN

Great Britain, Ireland and British Colonies, Coats Machine Tool Company, Limited—London—Newcastle-on-Tyne—Glasgow. France: Fenwick Freres & Company, 8 Rue de Rocroy, Paris.

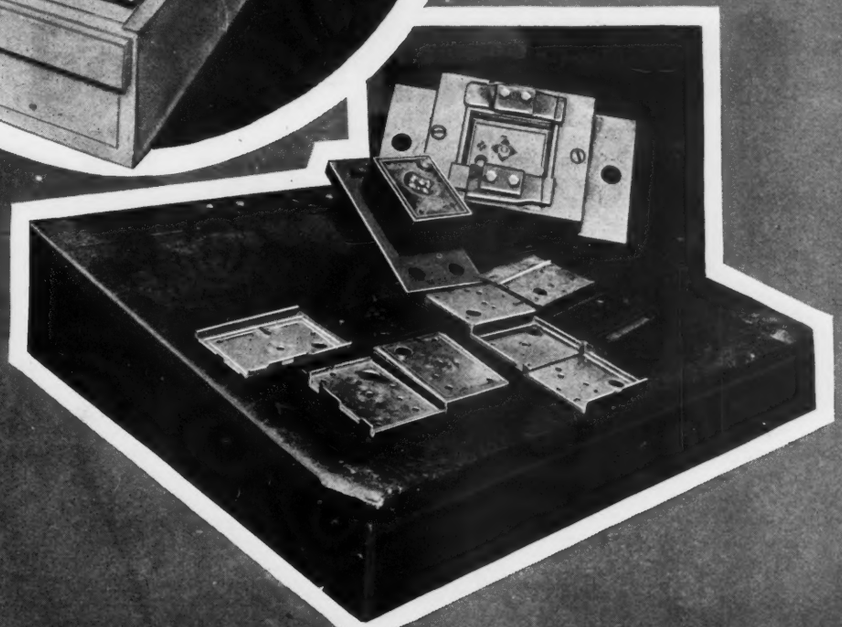
Colonial Red Star Tool Steel

TRADE MARK REGISTERED



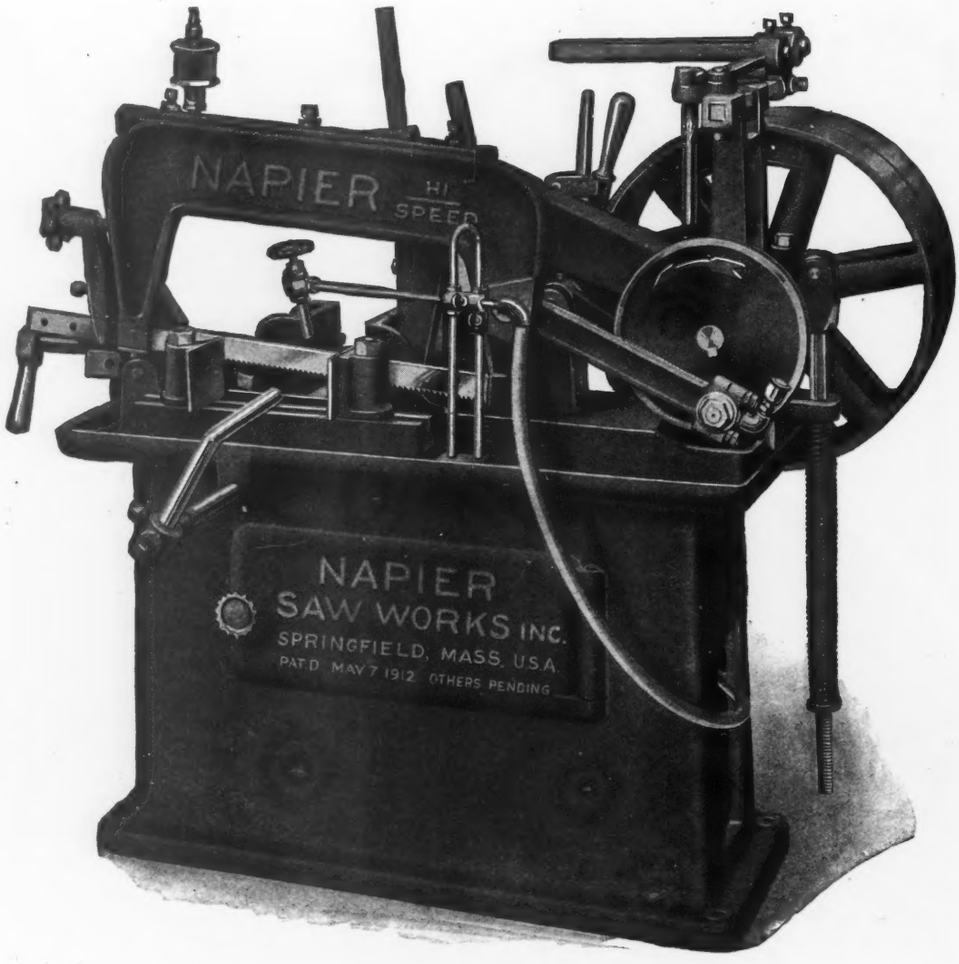
The lock manufacturer to whom we are indebted for these photographs is one of the biggest in his field—his locks are known and used all over the world. He buys Red Star Colonial Steel for dies—uses it for a wide variety of requirements—finds it the most satisfactory steel—most economical.

Colonial Red Star will meet most or all of *your* tool requirements—*most profitably.* Ask to be shown.



COLONIAL STEEL COMPANY

Pittsburgh New York Detroit Boston St. Louis Philadelphia Chicago



Napier Hi-Speed Hack Saw Machine

AN automatic spring tension feed that does away with the old method of gravity feed so destructive to blades.

This machine takes the vibration almost entirely from the small teeth of the Hack Saw Blade—an achievement impossible with any other system of feed.

Vibration absorbed means that blades will last much longer.

Has automatic lifting device, and lubricating system. Can be adjusted easily to give any desired pressure on blade.

A rugged tool for economy and production. Write for descriptive circular.

Napier Products

Band Saw Machines
Band Saws
Hack Saw Machines
Hack Saws

Napier Saw Works, Inc. No. 5 Napier St. Springfield, Mass.

12

Saws for Service

A cold saw must be right to give good service when, as is usually the case, it is handled by unskilled labor under the most trying conditions and with none of the consideration that accompanies the use of a lathe, miller or other machine tool.

We have sufficient data obtained in plants operating on work somewhat out of the ordinary to prove that the Lea-Simplex Cold Saw is one saw that *is* right.

The Lea-Simplex Cold Saw shown has its blade half way through a piece of steel tubing of five inches outside diameter and with one inch wall. This machine has been working on a wide variety of work for the last two years and has given unqualified satisfaction at all times.

Photograph and data through the courtesy of the Kutztown Foundry & Machine Company of Kutztown, Pa.



LEA—SIMPLEX Cold Saws

Lea-Simplex Cold Saws are simply constructed, have few working parts, and are readily accessible. Table may be raised or lowered, feeds and speeds varied and all other adjustments performed from one position. Ample clamping facilities eliminate the possibility of slipping, centrifugal pumping system keeps the blade well lubricated, up-feed of saw insures immediate chip removal by gravity. May we send the rest of the details?

The Earle Gear & Machine Company

4705 Stenton Avenue **Philadelphia, U. S. A.**



The Canedy-Otto Wall Type Radial

The "handy man" is rarely seen about the modern shop, but this handy drill press—Canedy-Otto No. 51—is firmly established in shops all over the country.

It has the "quality" construction of our massive floor type radials, with automatic cut off, instantaneous feed changes, quick return lever and other conveniences which adapt it to a wide range of drilling up to 1¼ inches.

By letting the walls supply the necessary support and omitting the base, with one or two other non-essentials, we have brought the price of a full fledged radial within the reach of every shop owner. **Details on Request.**

A LOW COST HIGH CLASS MACHINE

PRICES:

No. 51—2½ foot arm, $252.00
No. 51—3½ foot arm, 267.00
F. O. B. Chicago Heights

Carried in Stock by Leading Jobbers and Machine Dealers Everywhere

CANEDY-OTTO MANUFACTURING CO.

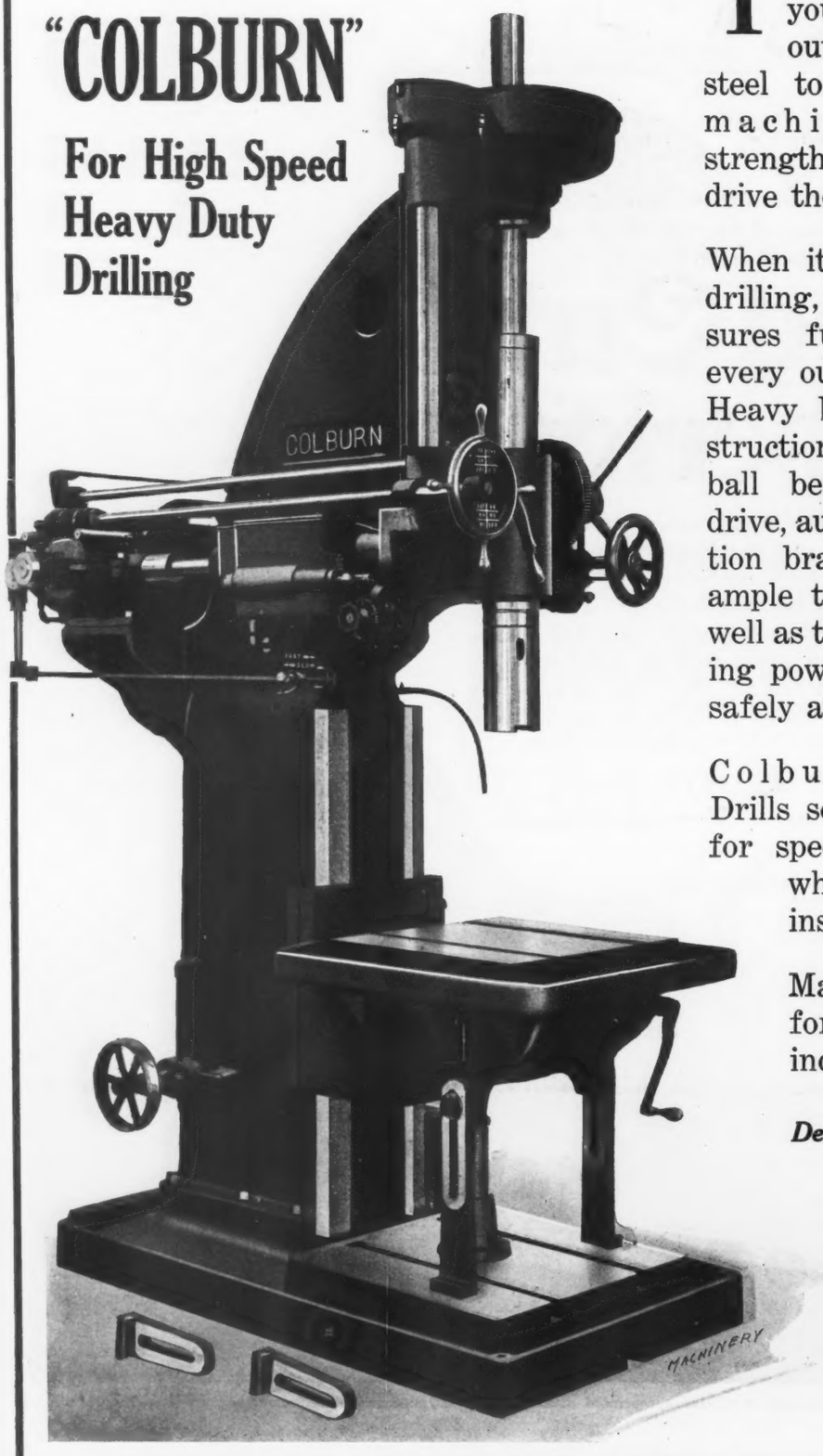
CHICAGO HEIGHTS ILLINOIS, U. S. A.



If interested in High Speed Steel and you care to receive our printed matter at intervals, send us your name and address for our mailing list

Rigid Construction and Abundant Power

The
"COLBURN"
For High Speed Heavy Duty Drilling



YOU'RE not getting your money's worth out of high speed steel tools, unless your machines have the strength and rigidity to drive them to capacity.

When it comes to heavy drilling, the "Colburn" assures full value from every ounce of tungsten. Heavy box column construction, all steel gears, ball bearing spindle drive, automatic trip, friction brake, etc., provide ample tool protection as well as the necessary pulling power to drive them safely at top speed.

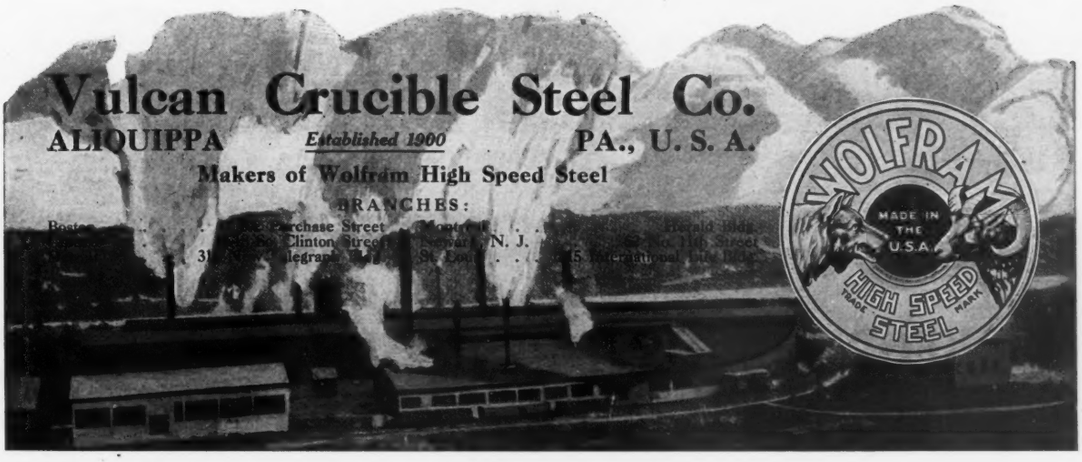
Colburn Heavy Duty Drills set new standards for speed and economy wherever they are installed.

Made in several sizes for drilling up to 5 inches in solid steel.

Details and production data on request.

COLBURN MACHINE TOOL CO.
Franklin, Pa., U.S.A.


WOLFRAM
HIGH SPEED
STEEL


Vulcan Crucible Steel Co.
ALIQUIPPA
Established 1900
PA., U. S. A.
Makers of Wolfram High Speed Steel
BRANCHES:
WOLFRAM
MADE IN THE U.S.A.
HIGH SPEED STEEL
TRADE MARK

FOR FINE JIG WORK

The Rockford Horizontal Drilling Boring and Tapping Machine

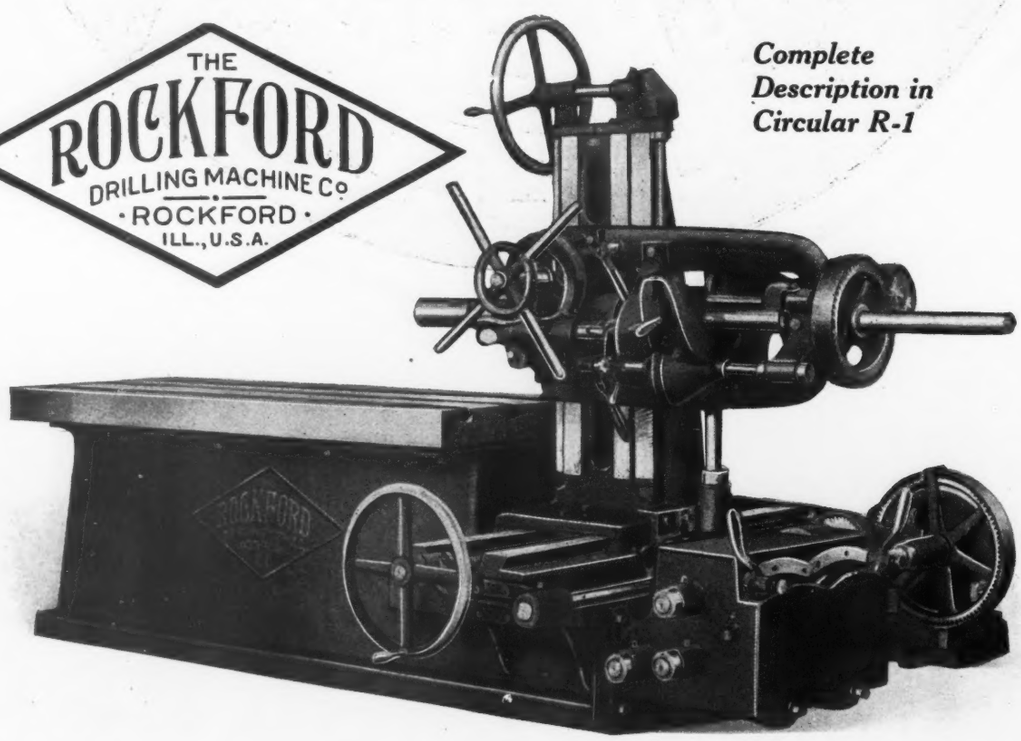
Designed to provide a heavy duty production tool with sufficient accuracy to handle the finest jig work, the Rockford "Horizontal" Drill is built extra heavy, is well balanced and equipped with journals and sliding surfaces of ample width and carefully ground.

The table is stationary and the working mechanism has lateral and vertical adjustment which permits the spindle to operate anywhere on a surface 18 inches high by 36 wide.

Spindle is of special high grade steel, with ball thrust bearings and capacity to drive 3 inch high speed drills and 8 inch boring tools—even larger if coarse feeds are avoided. The machine may be equipped with a variety of attachments and is made to drive with Two, Three or Four Step Cone, Gear Box with Tight and Loose Pulleys, Constant Speed Motor with Gear Box or Variable Speed Motor, directly connected.

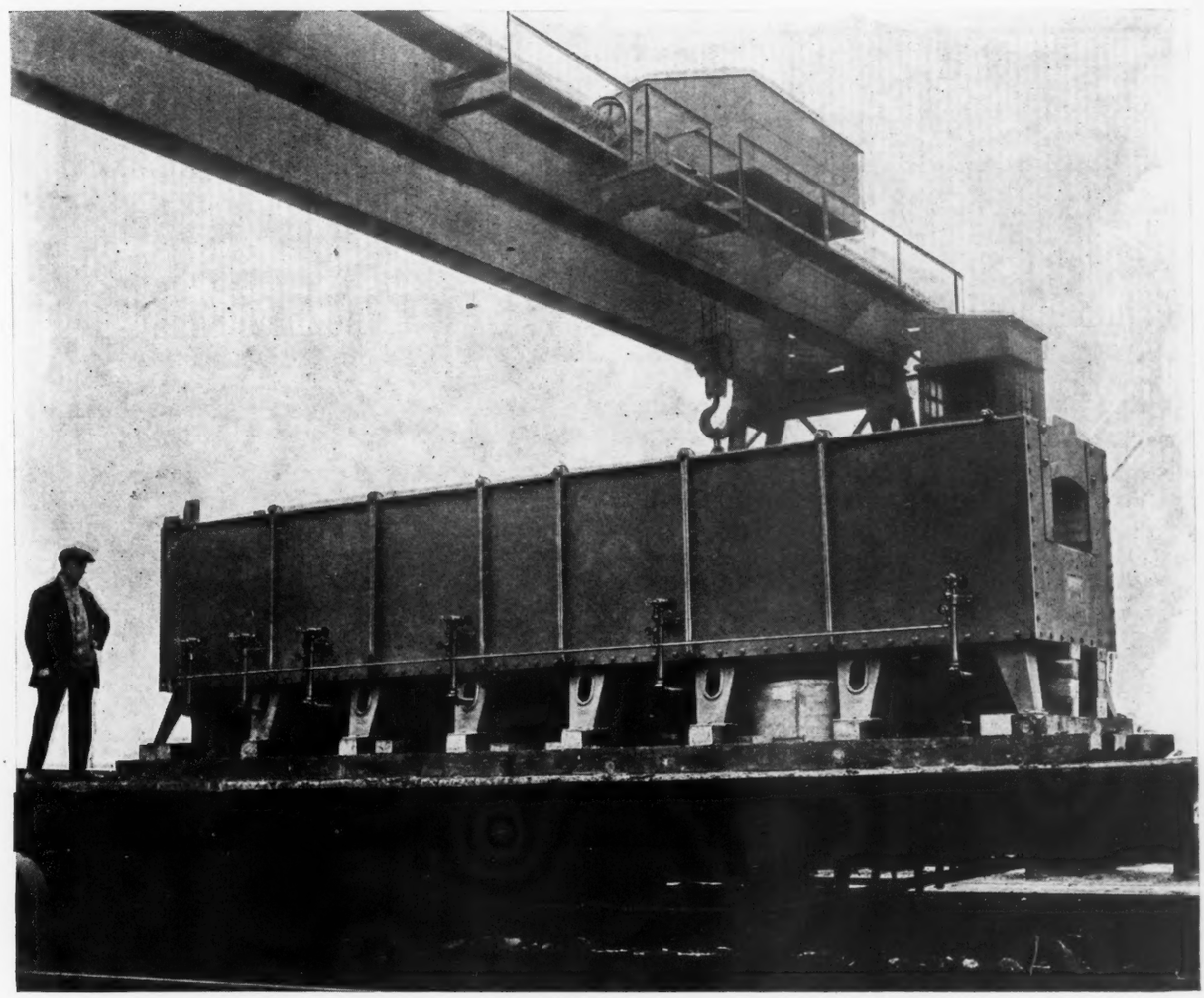
THE ROCKFORD DRILLING MACHINE Co. · ROCKFORD · ILL., U.S.A.

Complete Description in Circular R-1



ROCKFORD DRILLING MACHINE COMPANY

ROCKFORD **ILLINOIS, U. S. A.**



Ready for Quick Installation

Strong Carlisle & Hammond INDUSTRIAL FURNACES

For Oil, Natural Gas or Manufactured Gas

Catalog 8-M describes the full line of furnaces and accessories. When you write for it, ask any question you wish about heat-treating. The catalog and advice are both free.

When you buy a S-C-H Furnace you are buying quick results, not an erection problem. The illustration shows a 20 ft. shell furnace. After unloading, all that is necessary is to bolt on the doors and standards, connect the fuel and air and it is ready for business. No foundation to build, no mechanics or materials to clutter up your shop. It is ready to start producing a few hours after it is received.

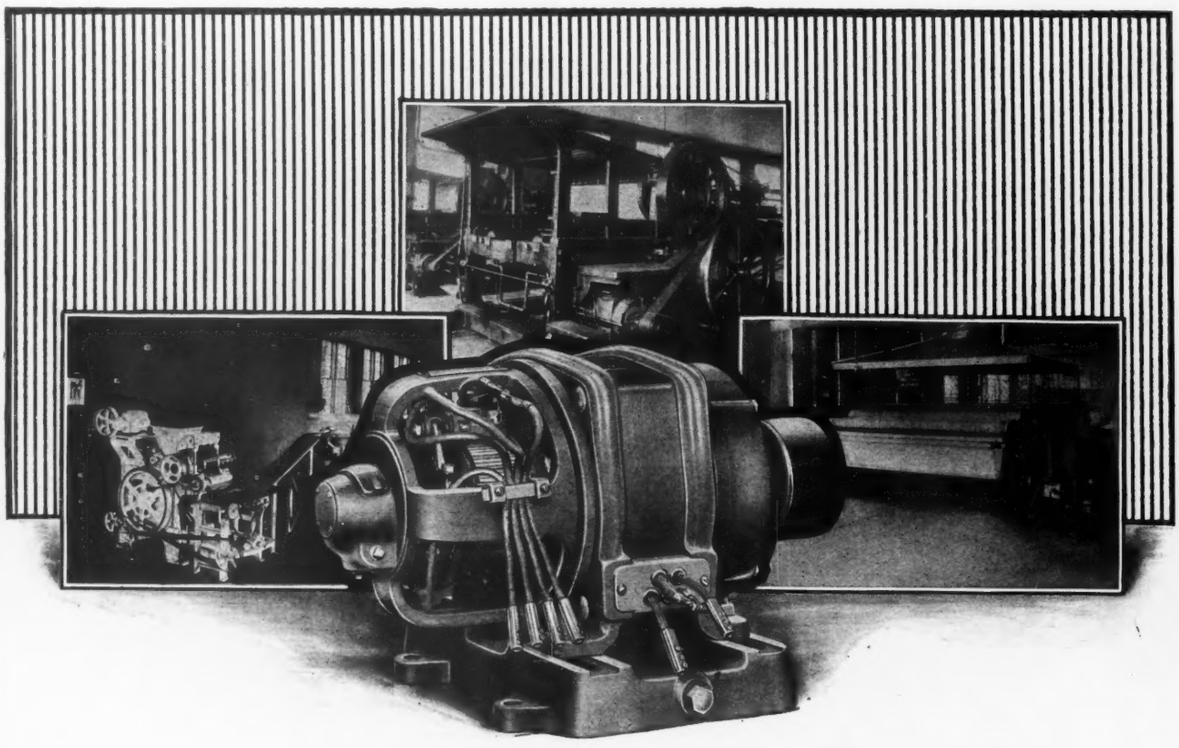
The smaller sizes are shipped complete and all that is necessary is to set them on the floor, connect the fuel and air and go to work.

The S-C-H line consists of 75 standard furnaces—a furnace for every possible heat-treating need. With them may be had every accessory that is used in a heat-treating department.

THE STRONG, CARLISLE & HAMMOND CO.

FRANKFORT AVENUE CLEVELAND, OHIO

Boston New York Chicago ←BRANCHES→ Philadelphia Detroit Pittsburgh



RI Single Phase Motors

are particularly well suited to services where reversal of rotation is required—Elevators, Small Cranes, and Hoists—as well as certain machines used in bakeries, laundries and other industries.

Standard 60-cycle non-reversing continuous duty type RI motors can be made reversible at reduced intermittent duty rating by simply bringing out extra leads from the windings to a double-pole, double-throw switch.

The type RI reversing motors are built in sizes from 1/4 to 5 h.p., 110/220 volts.

Shipment on popular sizes and frequencies can be made from stock.

Call up the nearest G-E sales office or G-E Motor Agency for the size you need.

General Electric Company

Atlanta, Ga.
Baltimore, Md.
Birmingham, Ala.
Boston, Mass.
Buffalo, N. Y.
Butte, Mont.
Charleston, W. Va.
Charlotte, N. C.
Chattanooga, Tenn.
Chicago, Ill.
Cincinnati, Ohio
Cleveland, Ohio
Columbus, Ohio
*Dallas, Tex.
Dayton, Ohio
Denver, Colo.
Detroit, Mich.
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General Office: Schenectady, N.Y.

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Minneapolis, Minn.
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Niagara Falls, N. Y.
*Oklahoma City, Okla.
Omaha, Neb.
Philadelphia, Pa.
Pittsburgh, Pa.
Portland, Ore.
Providence, R. I.
Richmond, Va.
Rochester, N. Y.
St. Louis, Mo.
Salt Lake City, Utah
San Francisco, Cal.
Schenectady, N. Y.
Seattle, Wash.
Spokane, Wash.
Springfield, Mass.
Syracuse, N. Y.
Toledo, Ohio
Washington, D. C.
Youngstown, Ohio

*Southwest General Electric Company. For CANADIAN BUSINESS refer to Canadian General Electric Company, Ltd., Toronto, Ont.
GENERAL FOREIGN SALES OFFICES: Schenectady, N. Y.; 120 Broadway, New York City; 83 Cannon St., London, E. C., England.

45—5

Ready for the extra strain

Not only are Type T motors built to stand severe service steadily, but added strength is built into them that they may be ready for the extra hard pull. When the unusual strain comes you can be sure of reserve power to carry the overload both electrically and mechanically.

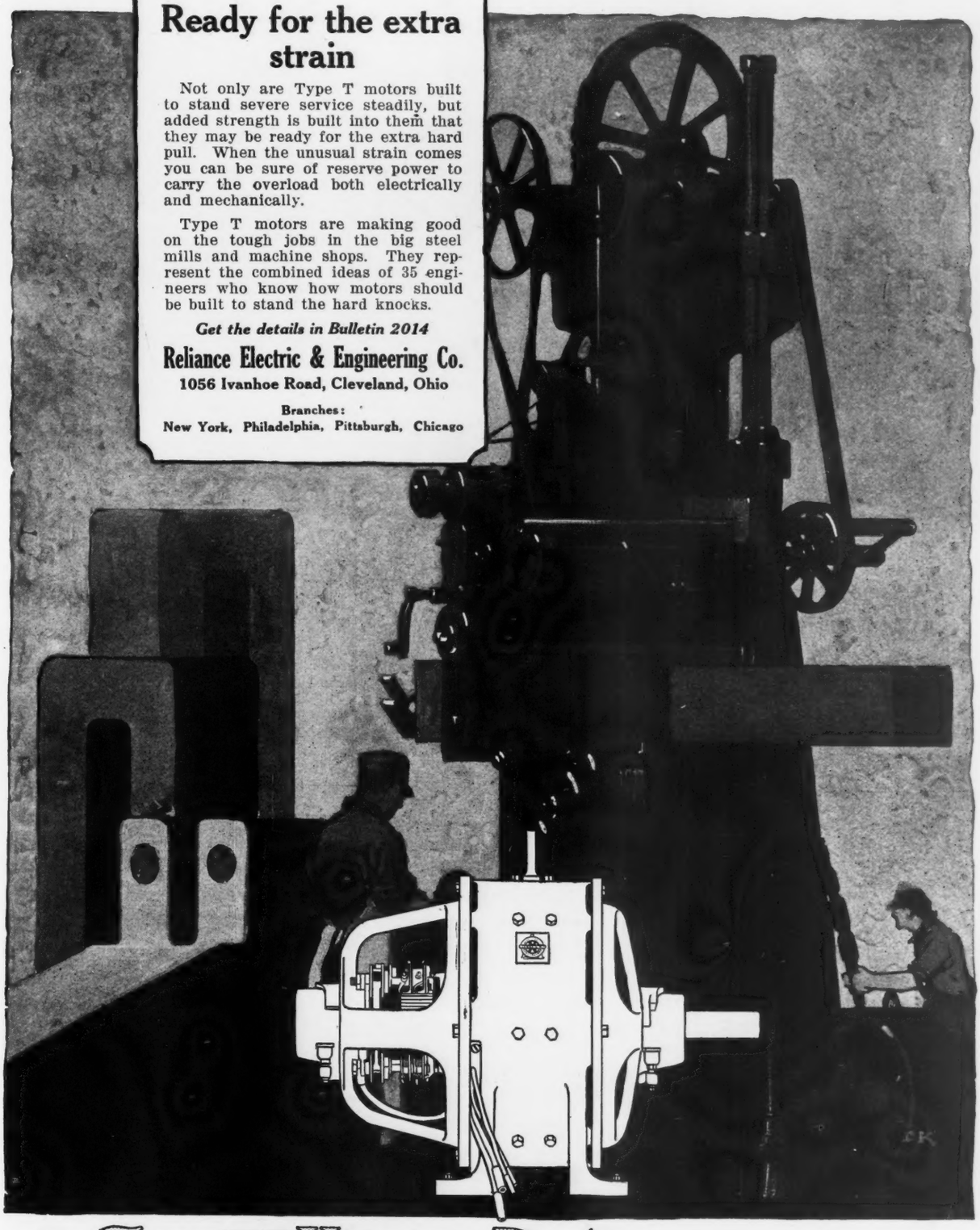
Type T motors are making good on the tough jobs in the big steel mills and machine shops. They represent the combined ideas of 35 engineers who know how motors should be built to stand the hard knocks.

Get the details in Bulletin 2014

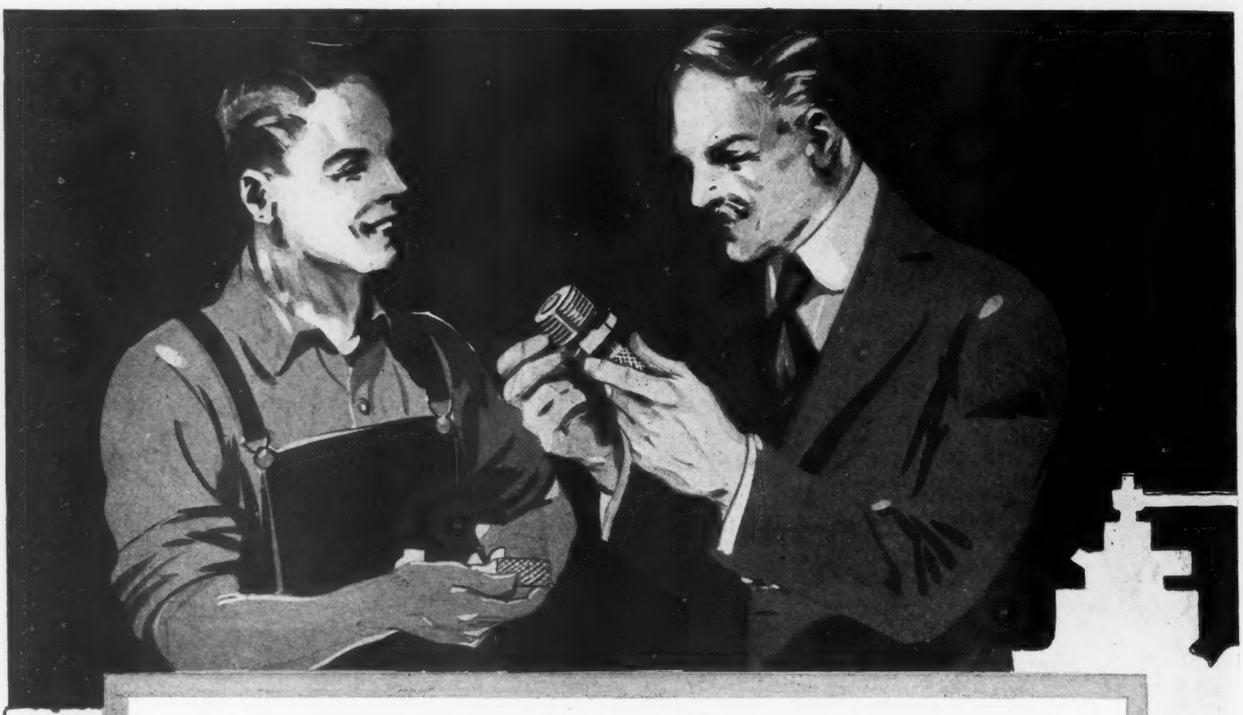
Reliance Electric & Engineering Co.

1056 Ivanhoe Road, Cleveland, Ohio

Branches:
New York, Philadelphia, Pittsburgh, Chicago



Type T Heavy Duty
RELIANCE MOTORS
Direct Current



That's what the men in the shop say. And that's what you will say about every job done with a DUMORE.

It sets a new standard of accuracy in tool grinding. Chatter marks, taper and bell-mouth are unknown. It is portable, easily carried from one place to another and quickly set up.

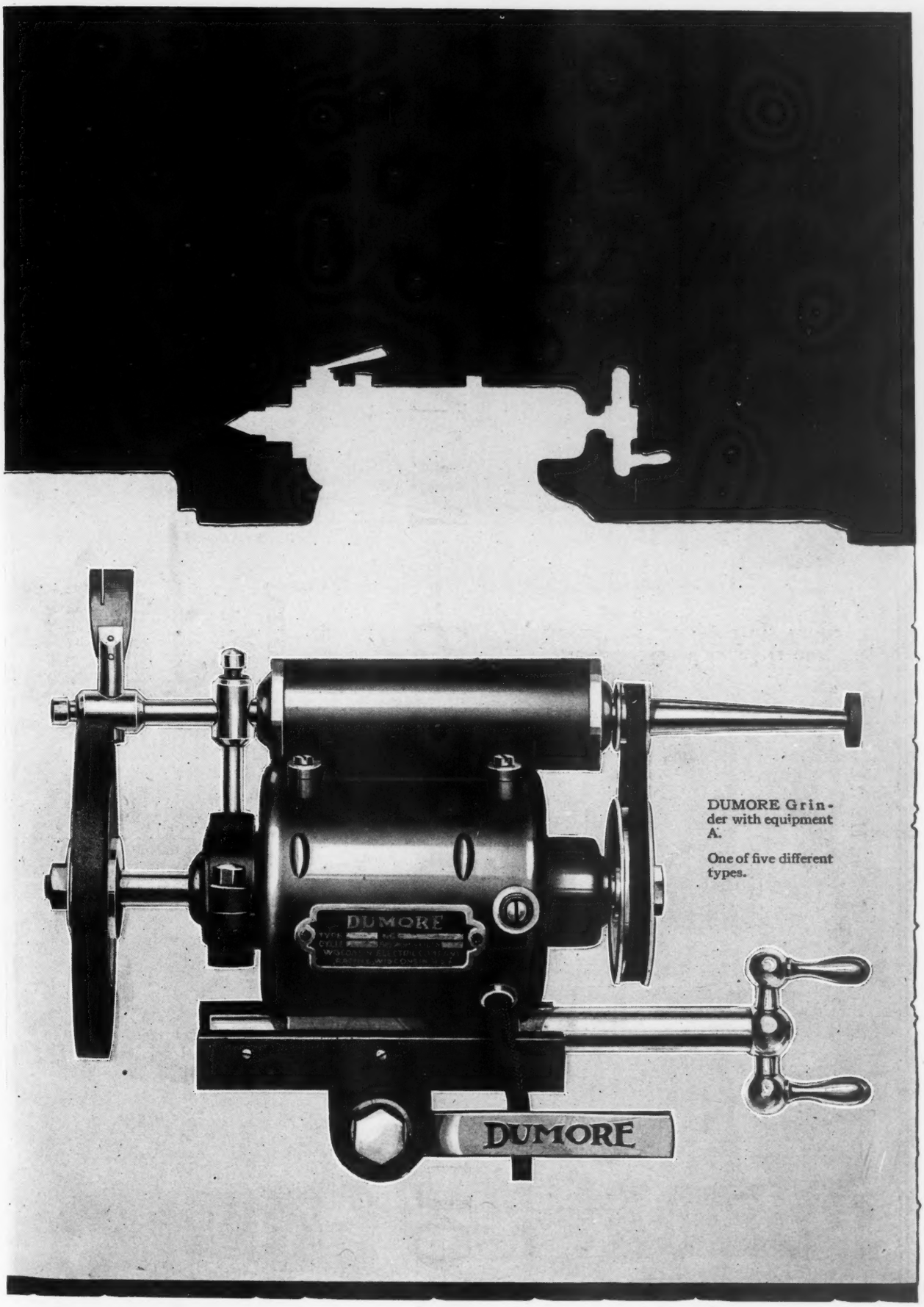
In principle, construction and performance the DUMORE grinder stands without an equal. The dynamic balance of the armature and the high spindle speed — 30,000 R. P. M.—insures an even, correct cutting speed to wheels, a high class tool, and absolutely accurate results.

No matter what your equipment is, you should have a DUMORE. Let us tell you more about it.

WISCONSIN ELECTRIC COMPANY

2500 16th Street RACINE, WIS.

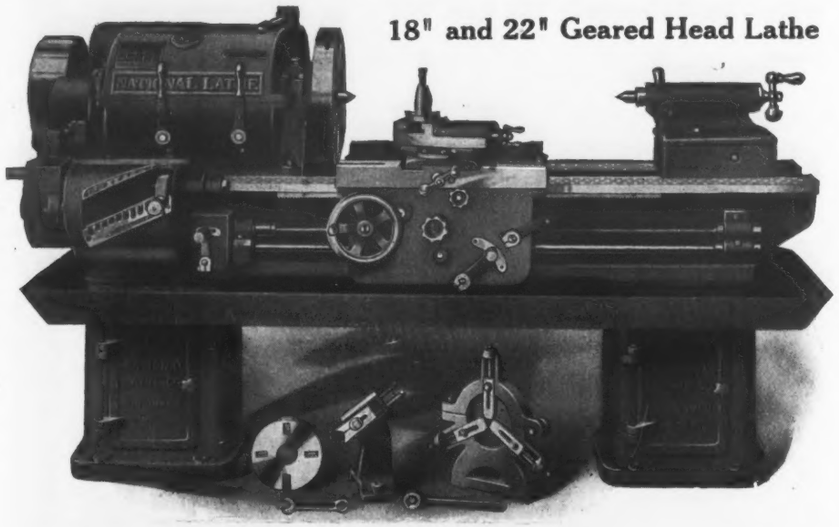
DUMORE PORTABLE ELECTRIC GRINDERS



DUMORE Grinder with equipment A.

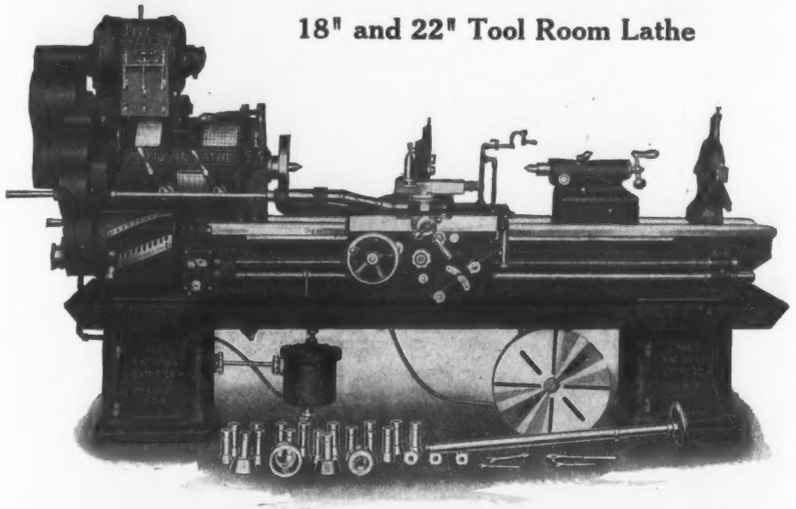
One of five different types.

18" and 22" Geared Head Lathe



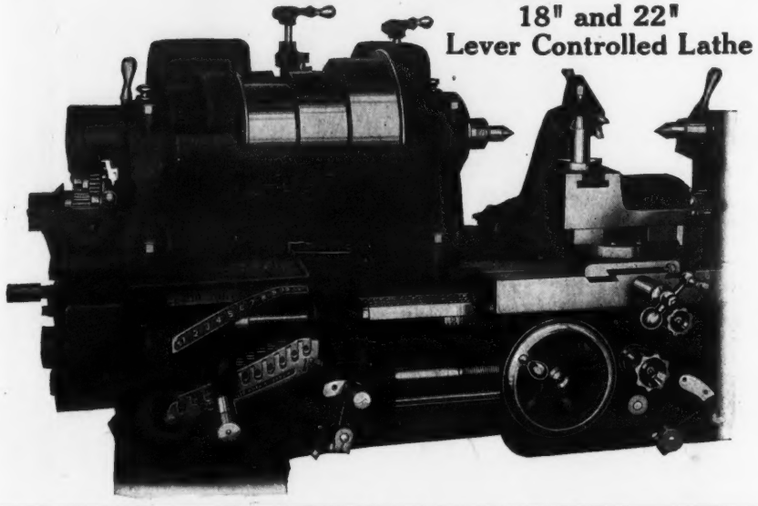
Another "Good One" is our National 24" Heavy Duty Lathe

18" and 22" Tool Room Lathe



FOUR GOOD ONES—NONE BETTER

18" and 22" Lever Controlled Lathe

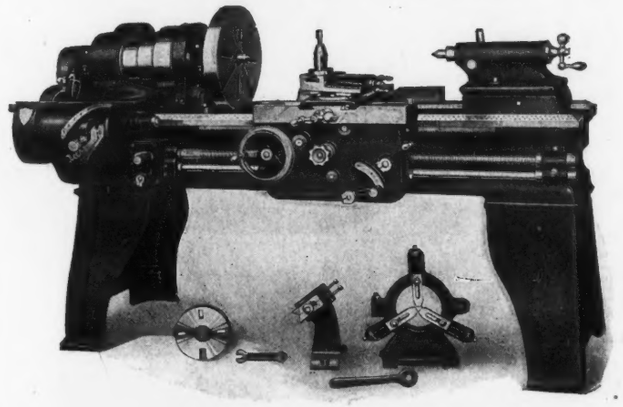


The National Lathe Co.

Cincinnati Ohio

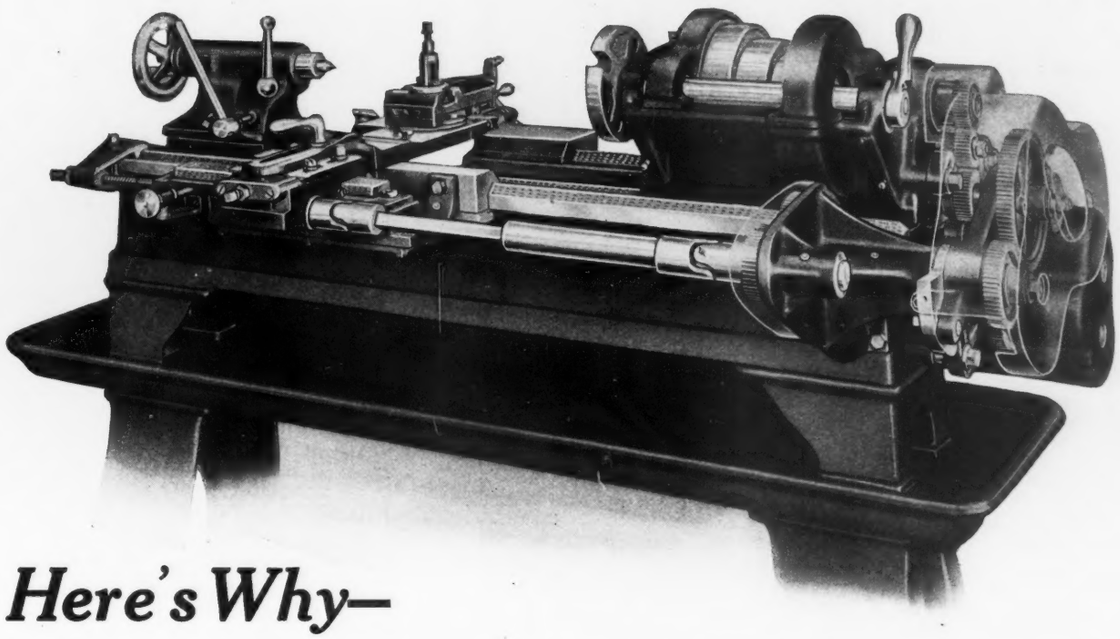
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17" and 20" Cone Pulley Lathe



THE MULLINER LATHE

Is The Ideal Lathe for Foreign Contract Work



Here's Why—

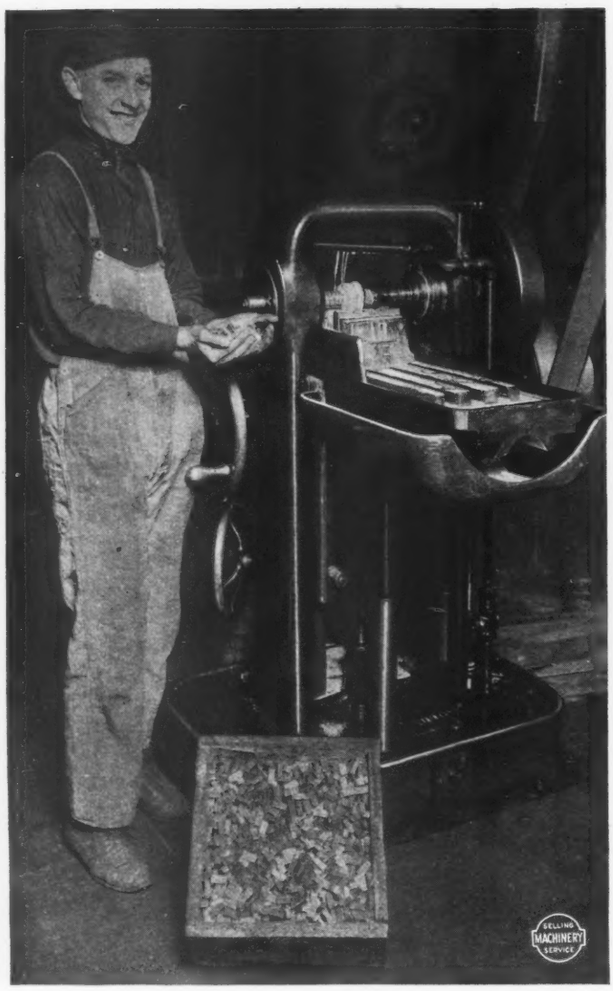
The Mulliner Quick Change Lathe is provided with an unusually wide range of feeds. It is equipped with an auxiliary quadrant also, located on the end of the bed, which carries the gears connecting the head with the quick change mechanism, and permits the use of such extra gears as will be necessary to cut *all special or metric threads* not regularly provided for in the standard equipment.

The metric transposing gears afford fifty metric leads ranging from 0.225″ to 16 millimeters pitch. The transposing formula shows the method of applying extra gears for metric threads not within this regular range.

This feature coupled with guaranteed accuracy to which a splineless lead screw materially contributes, makes the Mulliner Lathe ideal for metrically gauged contract work without necessitating a complete metric arrangement of the machine, to the exclusion of all other work.

Built in 12" and 14" sizes. Further details on request.

MULLINER-ENLUND TOOL COMPANY, Inc.
SYRACUSE **NEW YORK, U. S. A.**

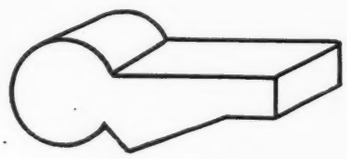


One Briggs Miller Helped

Now There Are Two

The Briggs Miller is milling pawls for Lowell Reversible Ratchet Wrenches made by the Lowell Wrench Company, Worcester, Mass. It took little more than a year for this company to decide that a second Briggs Miller could still further add to the growing popularity of its improved product. The two now installed are turning out an enormous amount of work, establishing beyond doubt their popularity in handling parts of this character.

Milling the Pawls for Lowell Reversible Ratchet Wrenches



To produce from the block the pawl shown in the accompanying sketch requires two milling operations—one finishing the upper half of the circular end and the flat surface to the left of it, the other finishing the lower half of the circular end and the various angular surfaces to the left of it.

No better machine for high production on this job than the Briggs Miller could be found. And for quality—well, you see what it did for this company's product. Will you give it an opportunity on yours?

Let us tell you more about this wide ranged machine

GOOLEY & EDLUND, Inc., Cortland, N. Y.

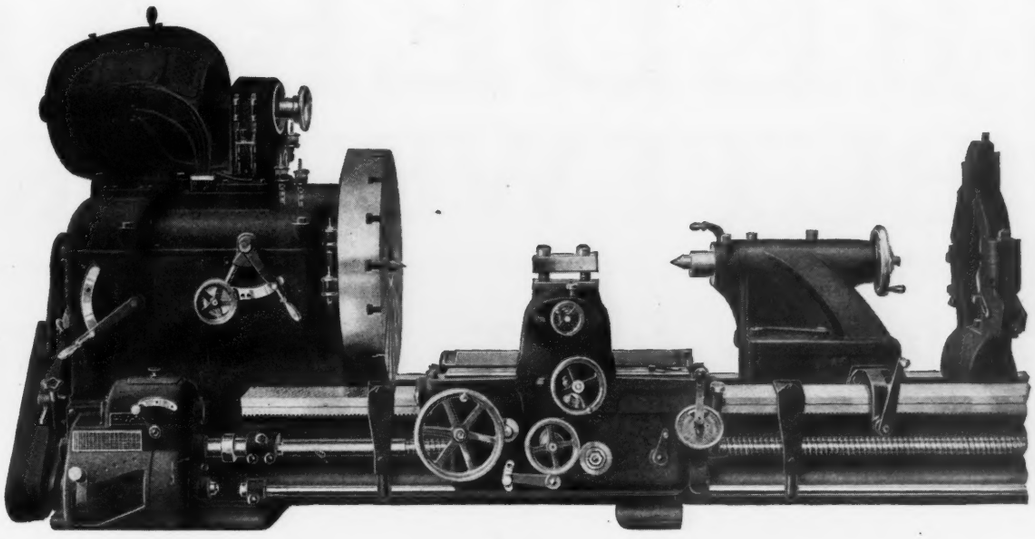
DOMESTIC AGENTS: Chandler & Farquhar Co., Boston, Mass.; Vandyck Churchill Co., New York and New Haven; Swind Machinery Co., Philadelphia, Pa.; Syracuse Supply Co., Syracuse, N. Y.; O. R. Adams, Rochester, N. Y.; Brown & Zortman Machinery Co., Pittsburgh, Pa.; English & Miller Machinery Co., Detroit, Mich.; Federal Machinery Sales Co., Chicago, Ill.; Vonnegut Machinery Co., Indianapolis, Ind.; Cleveland Tool & Supply Co., Cleveland, O.; Bowman-Blackman Mch. Tool Co., St. Louis, Mo. FOREIGN AGENTS: Burton, Griffiths & Co., Ltd., London, Manchester and Glasgow; Andrews & George, Tokyo.

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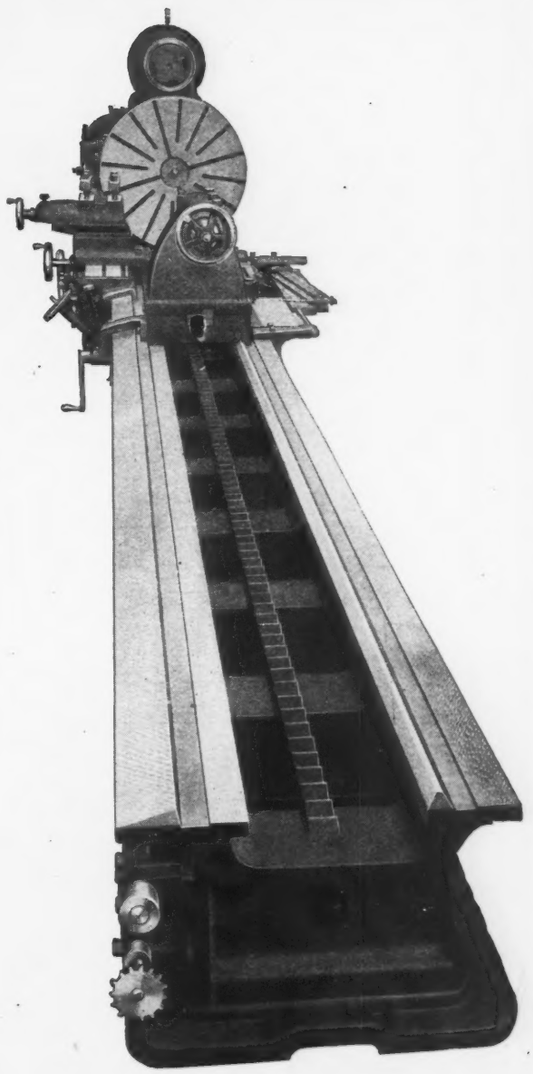
THESE are massive lathes of unusual power, as will be apparent on seeing them. They are essentially production tools, but their effectiveness adapts them for all lathe work.

All steel gearing. FORGED STEEL INTERNAL GEAR in face plate.

TOOTHED, POSITIVE CLUTCHES for carriage feeds.

Ninety-four different speeds by means of headstock containing only 10 gears in combination with 3:1 D. C. motor. Speeds cover range of nearly 200:1.

Lower view shows end of lathe and exhibits the front guide which constitutes the desirable "LONG NARROW GUIDE" for carriage. Carriage has gibs at front and under faces of guide which make it impossible for carriage to cock or lift.



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30, 36, 42, 48, 54 and 60 in. Sizes

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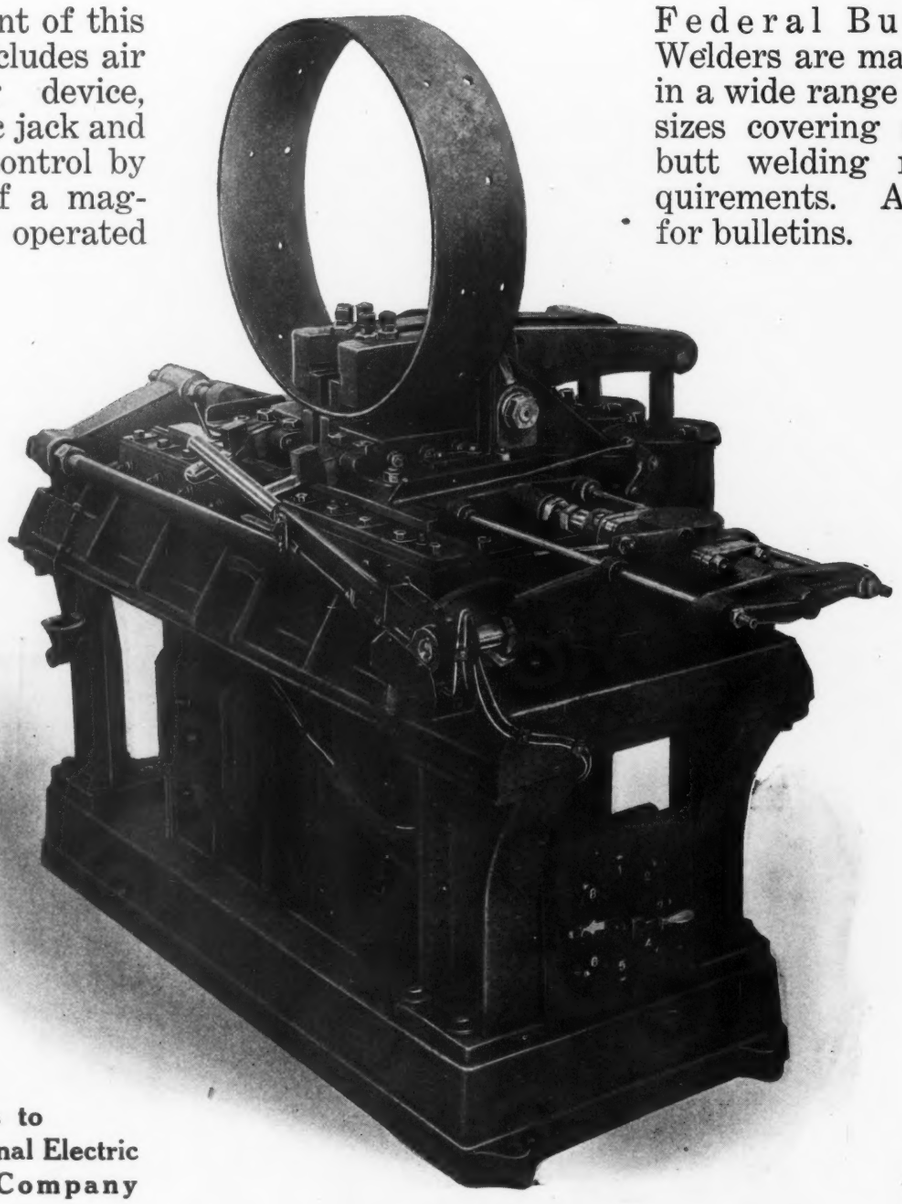
FEDERAL BUTT WELDERS

Welding Steel Tractor Wheel Rims

The accompanying photograph shows a 15-A Federal Butt Welder set up for welding steel tractor wheel rims 24″ diameter, 3/8″ thick and 8″ wide.

Equipment of this model includes air clamping device, hydraulic jack and remote control by means of a magnetically operated switch.

Federal Butt Welders are made in a wide range of sizes covering all butt welding requirements. Ask for bulletins.

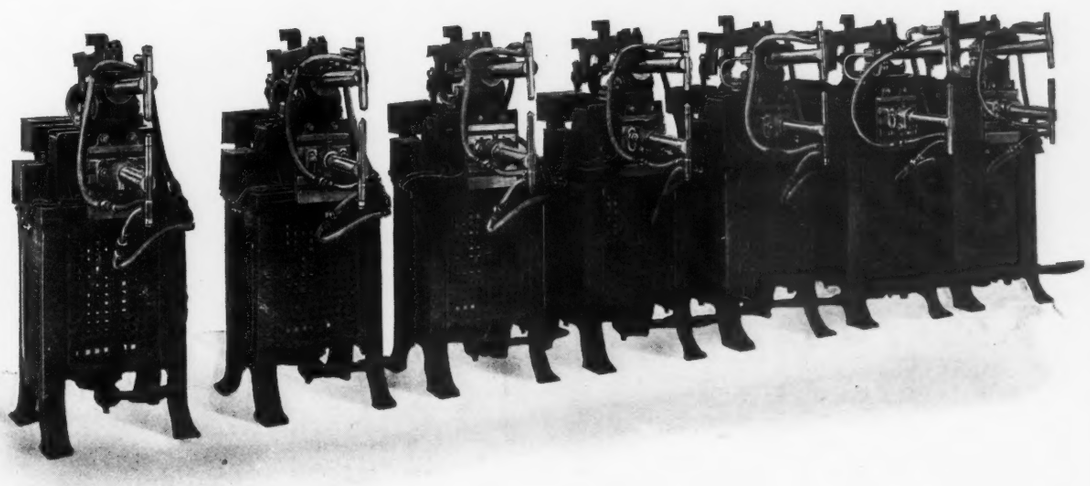


Successors to The National Electric Welder Company

THE FEDERAL MACHINE &

FEDERAL SPOT WELDERS

Proved Quicker and Better on This Important War Work

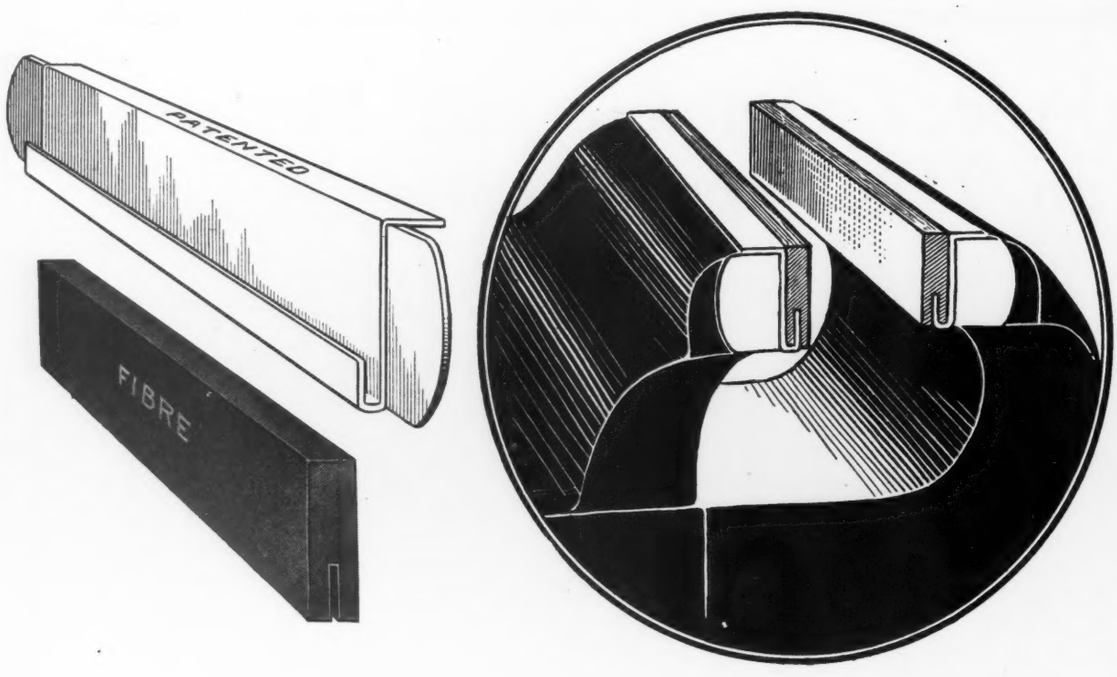


A certain large stamping concern agreed to supply a vast number of water-tight sheet metal parts for war work within an unusually short time. Riveting machines started the job; but the battery of seven "Junior" Spot Welders shown above was substituted as both quicker and better. The company's engineers estimated that the spot welded parts produced by seven operators in a given time were five times as great as could be assembled with punch presses and rivets. Besides there **could be no rivet leaks in the finished parts.**

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Columbus Belting & Supply Co., Columbus, O.
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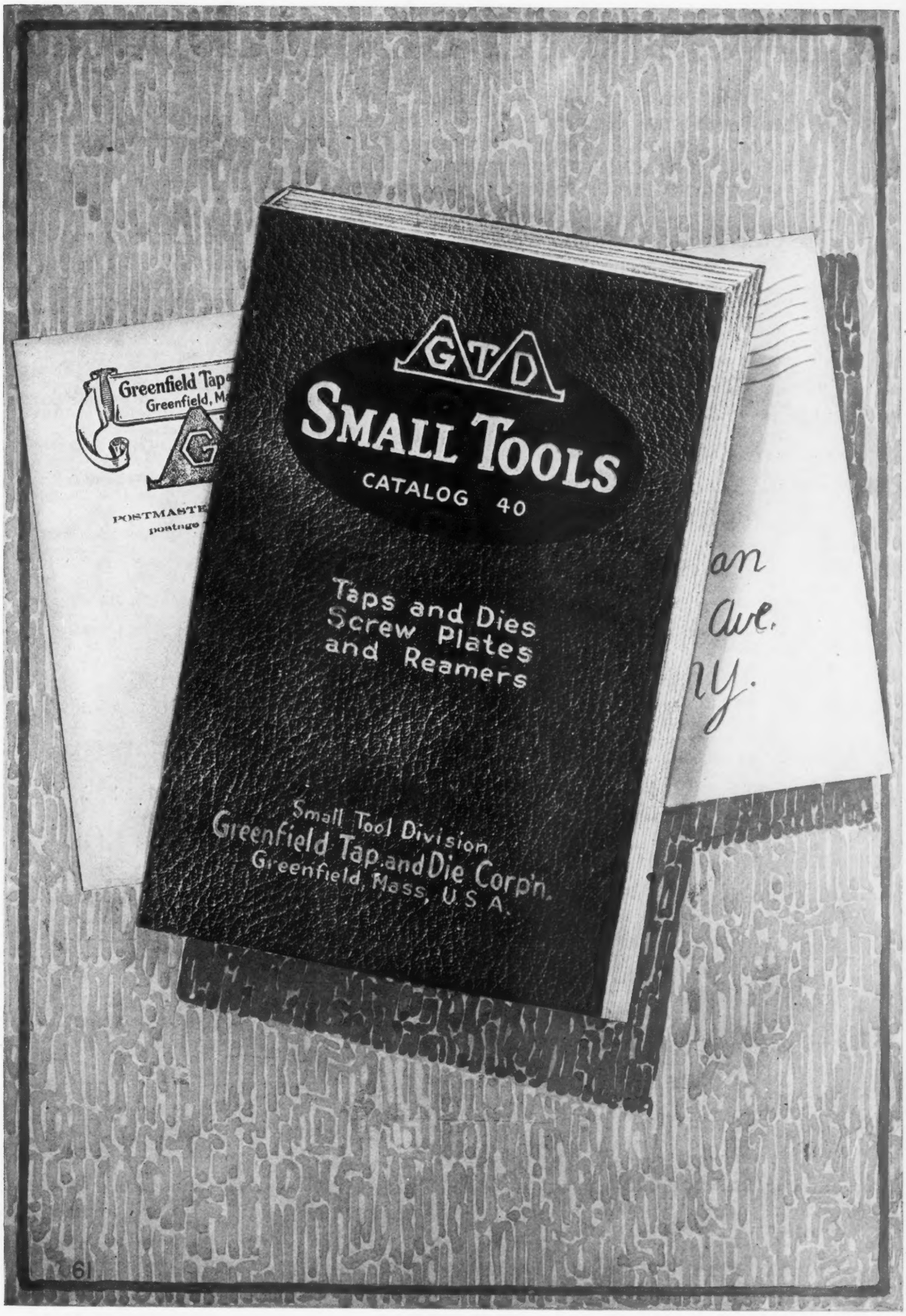
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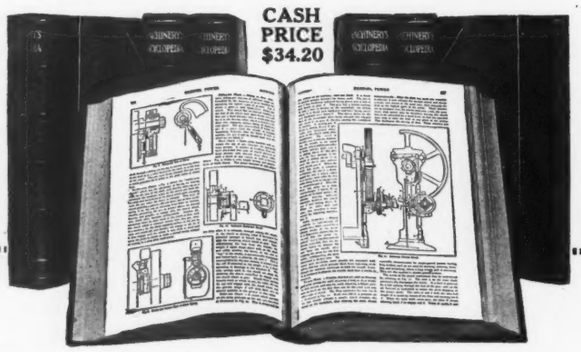
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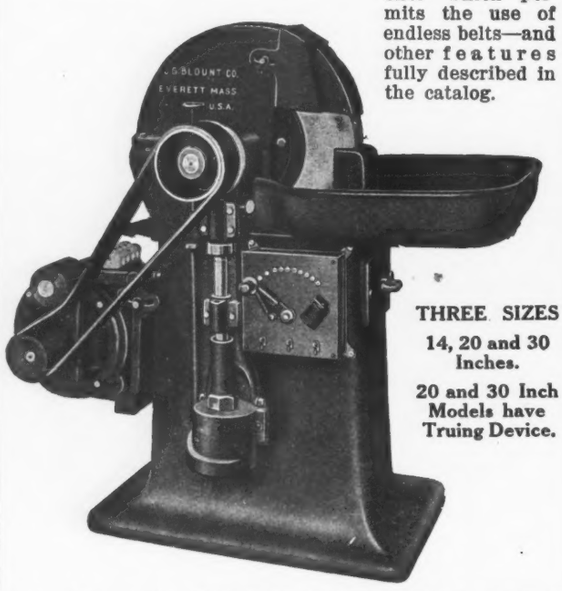
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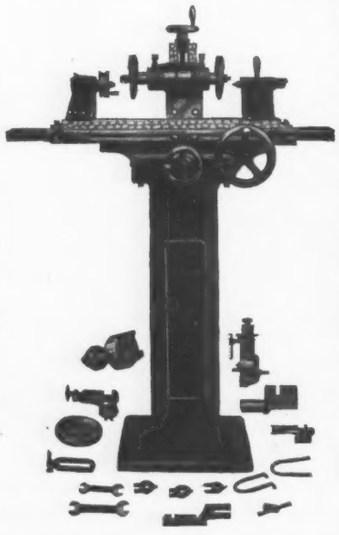
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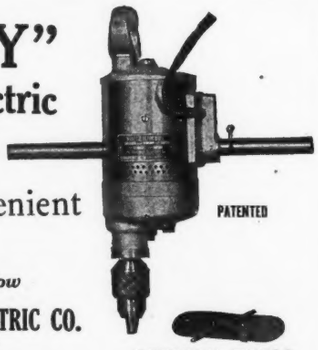
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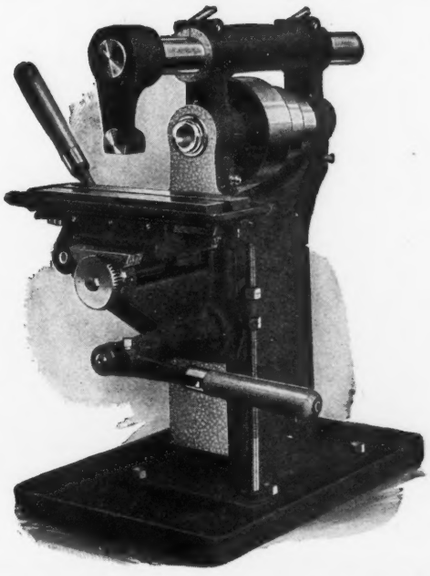
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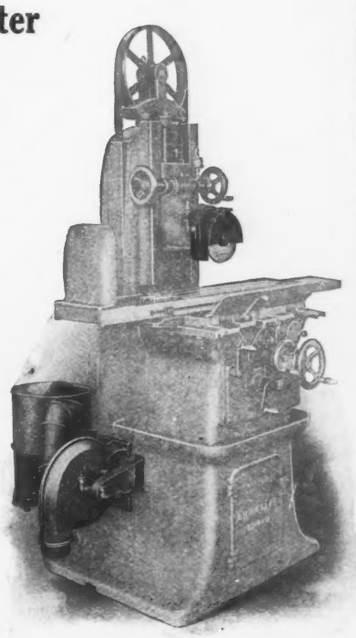
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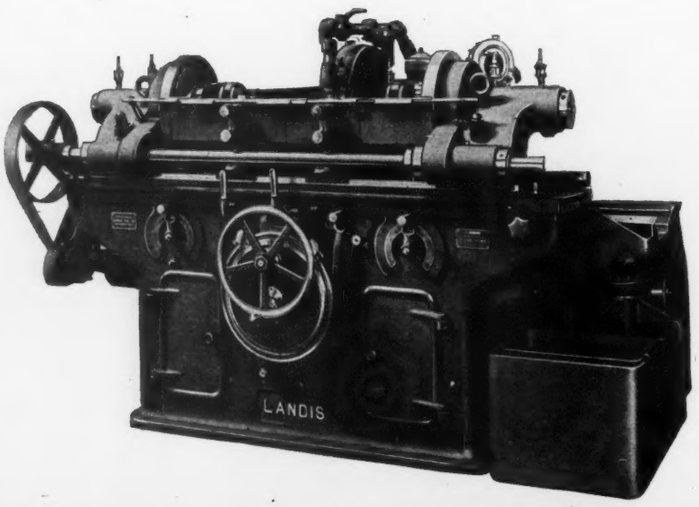


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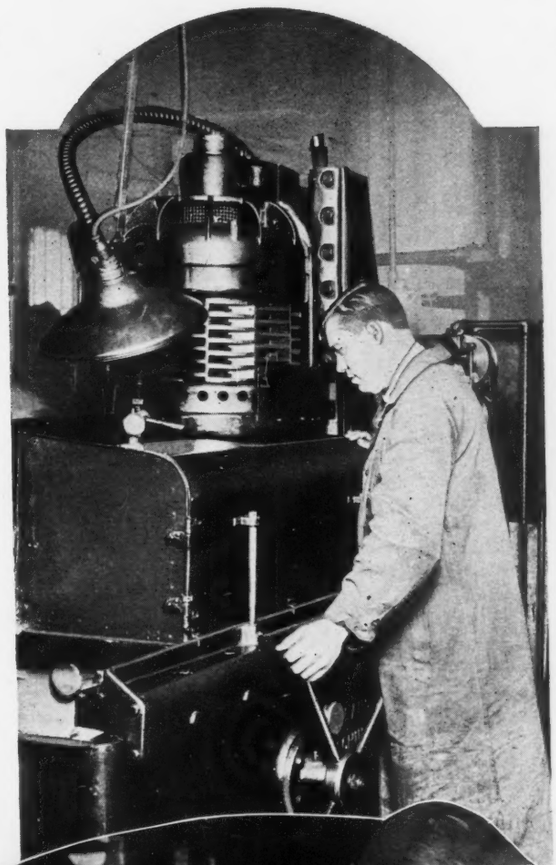
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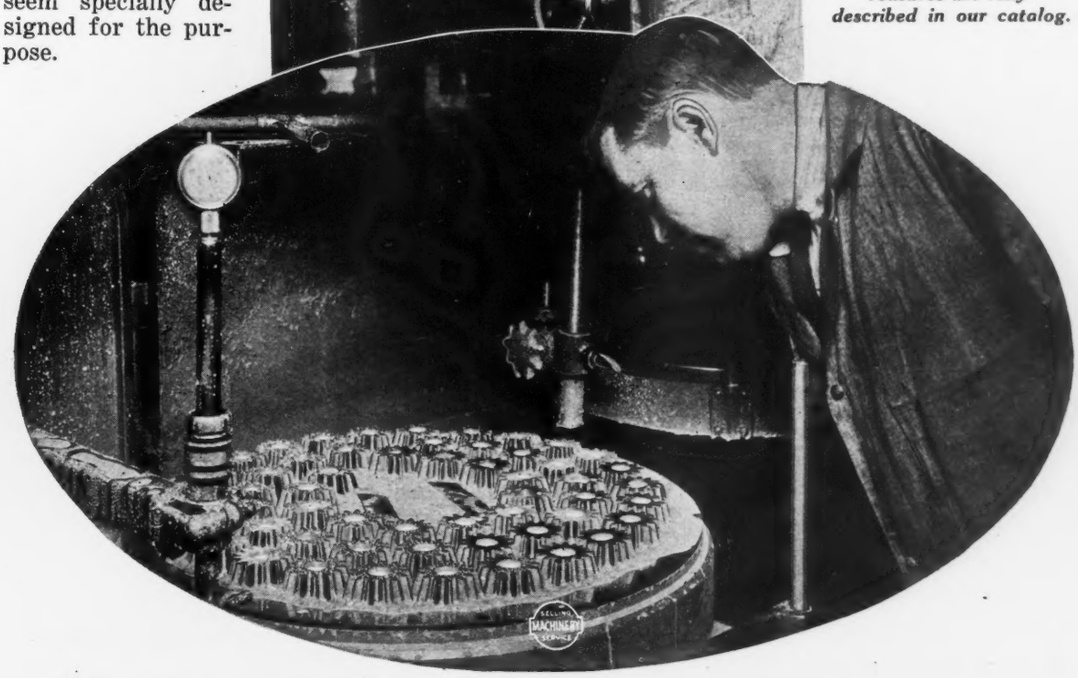
A new job every few hours, is the order of the day for this "Blanchard" at the New Process Gear Corporation plant, and it is so readily adapted to each in turn as to seem specially designed for the purpose.



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The "New Process" people have used this machine for *four years* and are better satisfied every day.

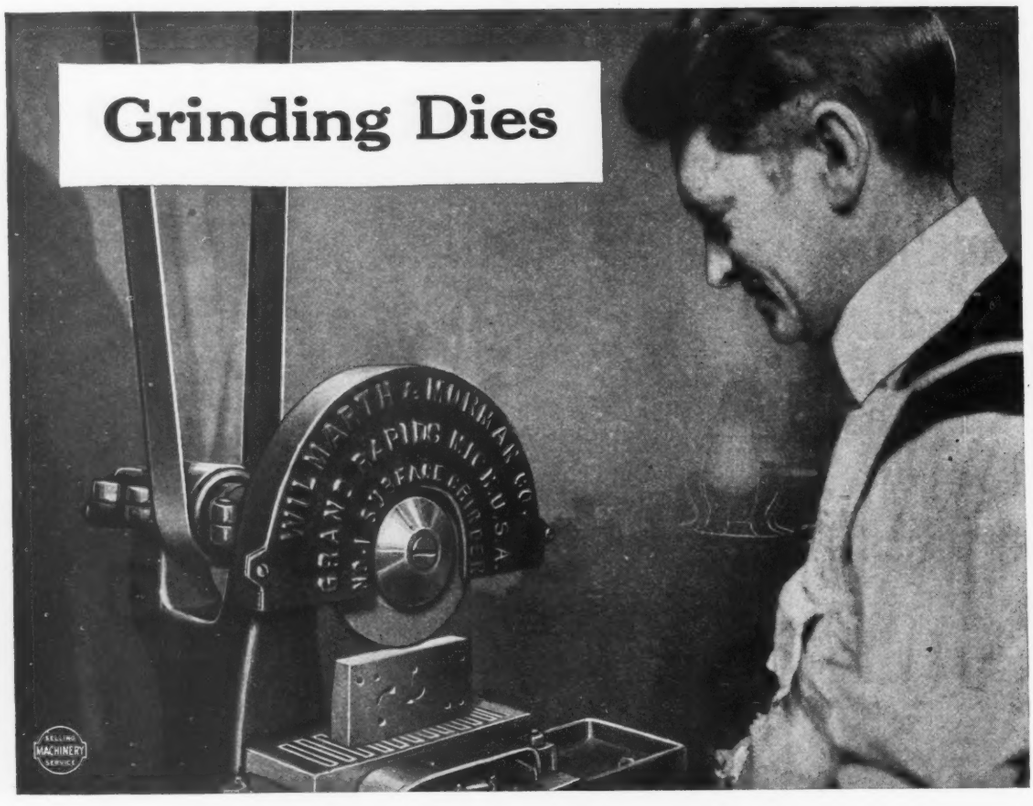
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Let us tell you more about it

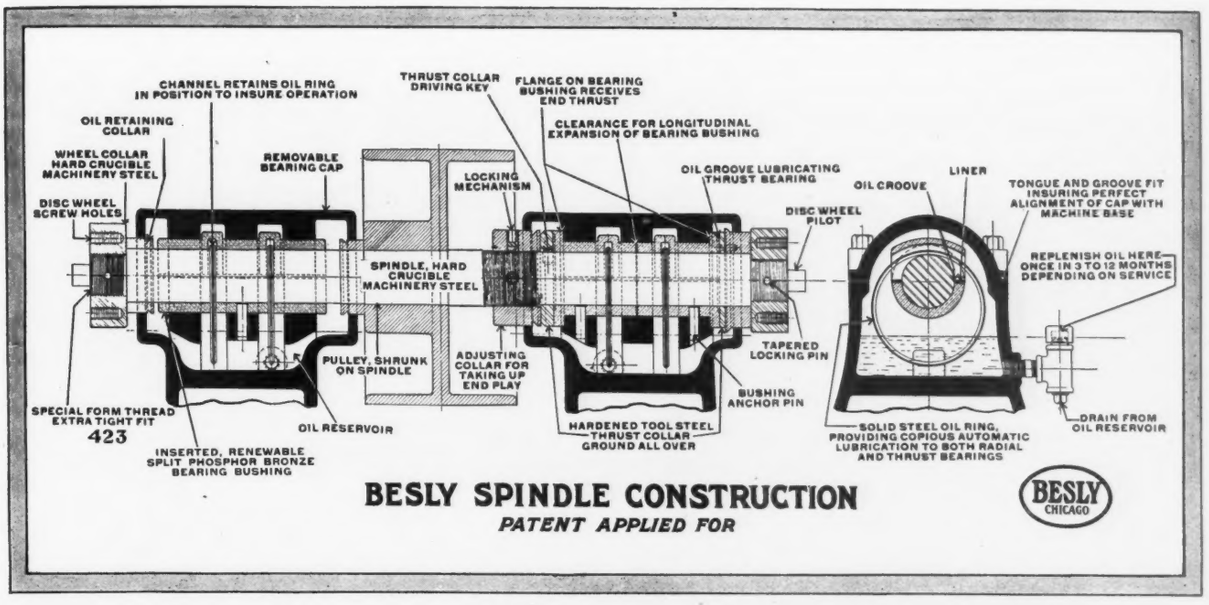
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A perfect "flood" of oil is continuously transmitted to Radial and Thrust bearings while grinder is running. The oil channels in faces of thrust bearings are of a special design which sets up a pumping action—forcing the oil copiously between the thrust collars.

BEARING BUSHINGS

Bearing bushings are split, inserted and renewable; of a special Phosphor Bronze. Bearing surfaces are of such large proportions that there is practically no wear.

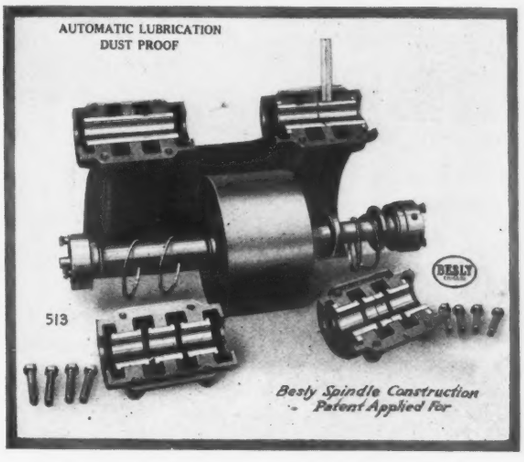
THRUST PROVISION

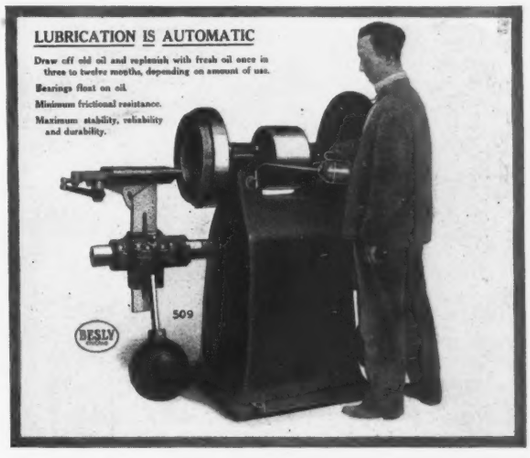
End thrust is taken on hardened and ground tool steel collars against the flanged ends of right-hand bearing bushings. End play is taken up easily, accurately and quickly by means of adjusting collar threaded on spindle and located under rim of spindle pulley.

ALL END PLAY TAKEN UP

The BESLY GRINDER may be safely operated with all end play taken up in spindle. The Bronze Bearing Bushing which receives the end thrust is provided with clearance to compensate for any expansion which may take place in the bushing. Therefore, it is impossible for this bearing to bind between the thrust collars, and seize.

This is a very important feature, as any looseness or end play in spindle will naturally affect the accuracy of the work to be ground.





INSIST ON BESLY GRINDERS

BESLY CHICAGO

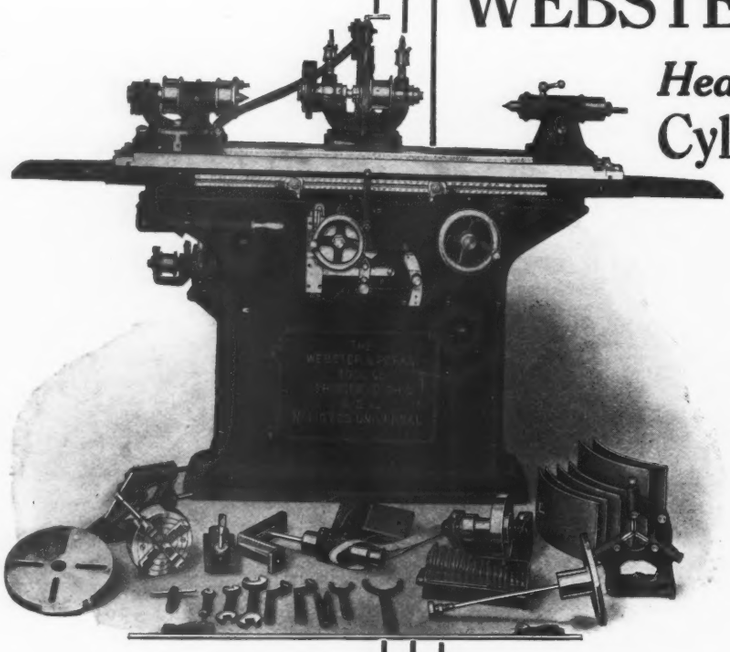
CHARLES H. BESLY & CO.

Originators of Disc Grinders

120B North Clinton Street, CHICAGO, ILL., U.S.A.

WEBSTER & PERKS

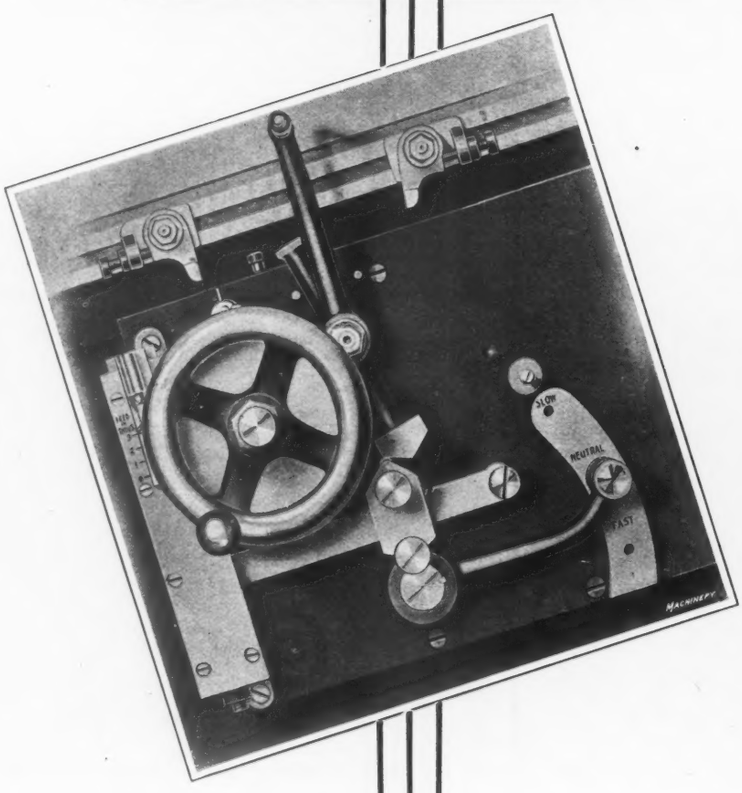
Heavy Duty Universal Cylindrical Grinder



A Machine of Unusual Features

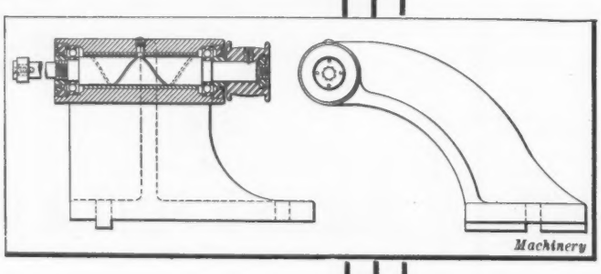
The new No. 1 (10″ x 30″) W & P Universal Cylindrical Grinder has a simple, positive automatic cross feed which provides a safe means of feeding the wheel at any predetermined point. Micrometer adjustment from 0.00025″ to 0.004″ is quickly obtained by simply turning knurled nut.

Hyatt Roller Bearing Countershaft is furnished, meaning lower power consumption and longer life for the countershaft; internal grinding attachment and counter-bracket, as well as dead center pulley, equipped with adjustable ball bearings; extremely rigid sliding table; heavy and uncommonly long head stock and head stock base.



Center illustration shows feed mechanism of this new machine; diagram below, the internal grinding attachment.

Let us send all the details on this modern Cylindrical Grinder. Twenty-five years of experience in grinding machine construction guarantee the correctness of this latest model.

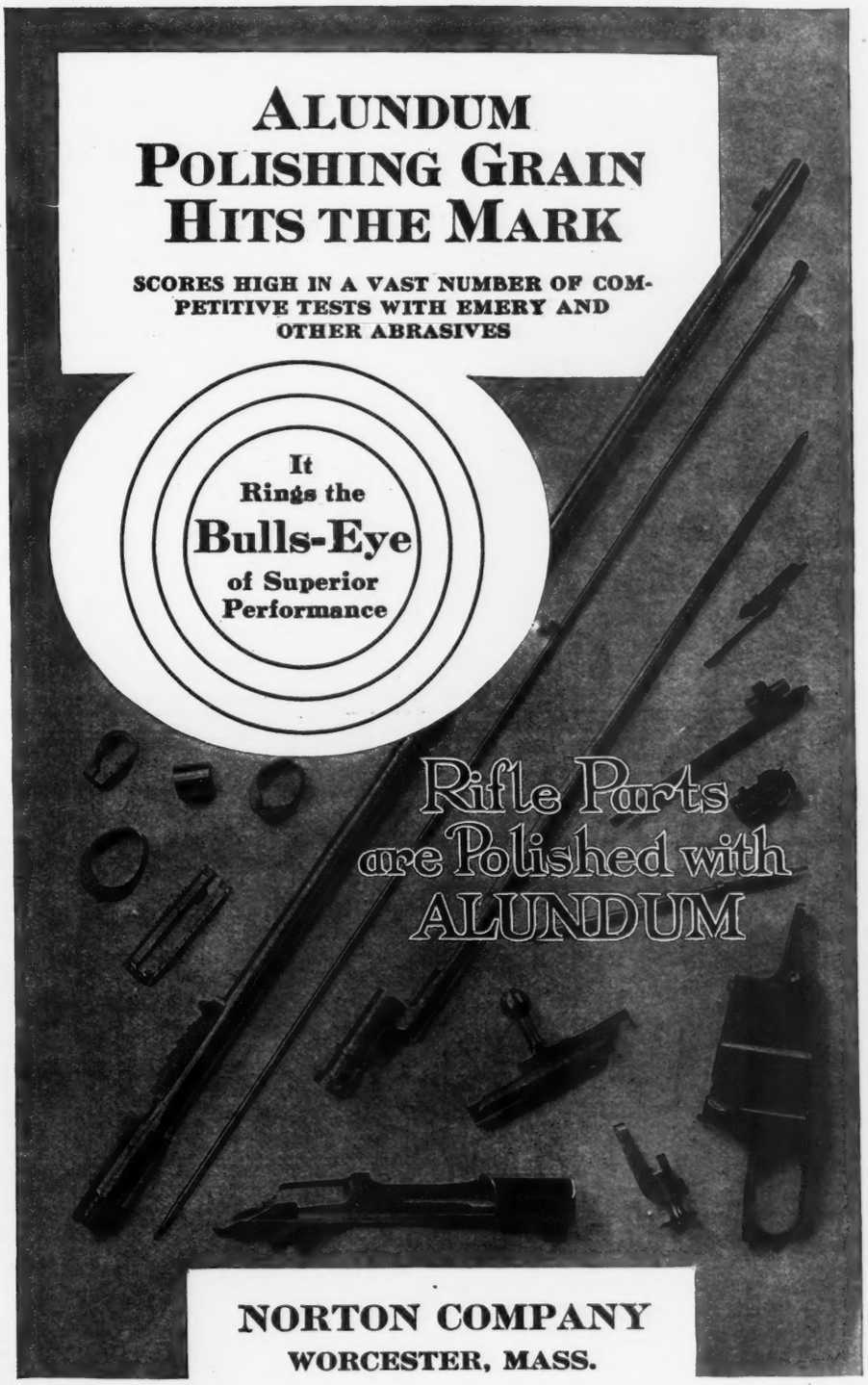


The Webster & Perks Tool Co.
Springfield Ohio, U. S. A.
P. O. Box 1301

ALUNDUM POLISHING GRAIN HITS THE MARK

SCORES HIGH IN A VAST NUMBER OF COMPETITIVE TESTS WITH EMERY AND OTHER ABRASIVES

It Rings the **Bulls-Eye** of Superior Performance



NORTON COMPANY
WORCESTER, MASS.

NEW YORK STORE
151 Chambers Street

ELECTRIC FURNACE PLANTS
Niagara Falls, N. Y. Chippawa, Ont., Canada

CHICAGO STORE
11 N. Jefferson St.

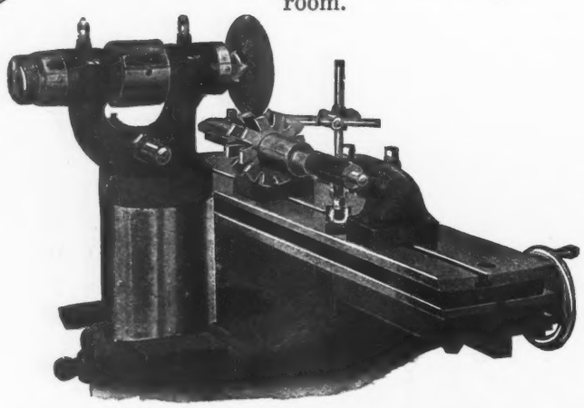
927

Universal in the correct sense of the word. It handles *all* work within its range.

Greenfield

TRADE MARK REG. U.S. PATENT OFFICE

A strong, rigid, accurate and convenient grinder. An ideal machine for any tool room.



The "Quick Change" Universal Grinder

Set-ups on the Greenfield Universal Grinder—21 in all—may be quickly and easily changed to accommodate work. This is an important feature in the busy tool room. Changes provide for grinding straight, taper and rose reamers; flutes of taps, tapered arbors, flat keys, gauges, flat bar work, slitting saws, small internal work, countersinks and counterbores; spur, bevel, spiral, formed, and end milling cutters; angular, small end, gear, convex and inserted tooth cutters.

GREENFIELD MACHINE CO.
Greenfield Mass., U.S.A.

GM

DETROIT WHEELS

"Give the best possible results from a given amount of time and cost."

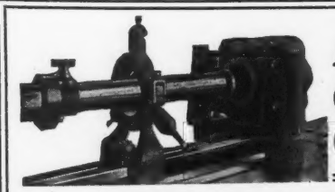


Turned, Trued and Balanced

The wire web construction of Detroit Grinding Wheels makes them just that much stronger and better adapted to resist centrifugal strain. They are uniform, made in all grades in a range of shapes and sizes to meet every grinding requirement. Cool, free cutting, long wearing wheels which can be absolutely duplicated.

Write us your needs

Detroit Grinding Wheel Company
Detroit Michigan, U. S. A.



Perfection CYLINDER GRINDER

A durable, economical attachment for cylindrical grinding on hollow spindle lathes with a swing not under 14".
A self-centering device and micrometer attachment permit extremely accurate grinding.

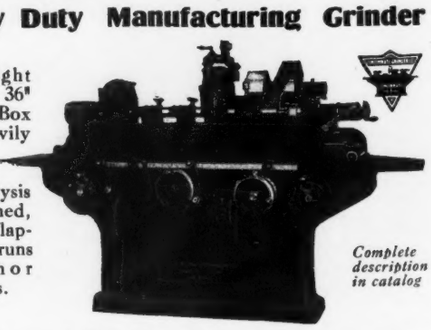
Capacity Model "A" from 2" to 6½". Model "T" from 6" to 12" diameter. Circular.

WOOD & SAFFORD MACHINE WORKS
GREAT FALLS MONTANA

The "CINCINNATI"

A Heavy Duty Manufacturing Grinder

Made in eight sizes — 12" x 36" to 16" x 80". Box section, heavily ribbed base. Spindle of special analysis steel is hardened, ground and lapped and runs in phosphor bronze boxes.



Complete description in catalog

The Cincinnati Grinder Co., Cincinnati, Ohio, U. S. A.

The Fraser Universal Grinding Machine

Accurate, speedy, efficient, this adaptable machine will handle any class of grinding not requiring special features.

It is an ideal machine for the all-round shop where grinding needs are varied. Easily convertible for cylindrical, surface or internal grinding, it embodies a small grinding department in itself and each separate job is evidence of its ability for accurate finished work.

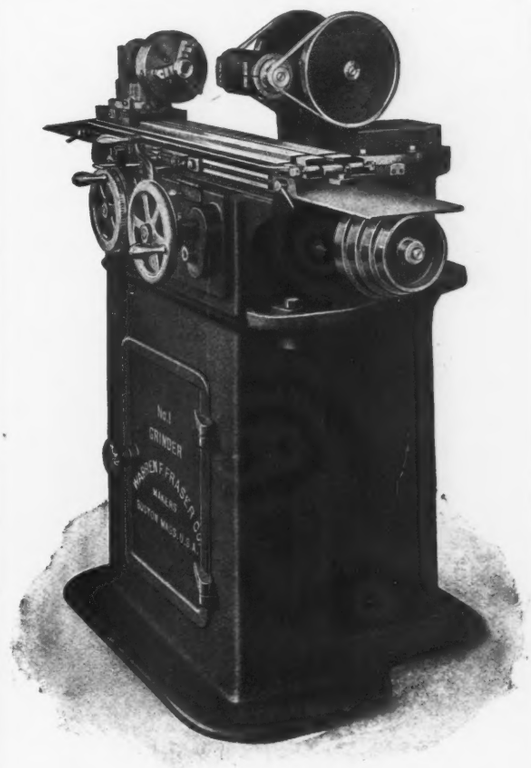
Let us explain the possibilities of the Fraser Universal Grinding Machine

The Warren F. Fraser Co.

FACTORY AND GENERAL OFFICES

Westboro, Mass., U. S. A.

BOSTON BRANCH: 201 Devonshire Street



Capacity: Cylindrical work, 8"x20"; Flat work, 5"x20"; Internal Grinding up to 8" outside diameter.



OTT GRINDER COMPANY

217 West Tenth Street

INDIANAPOLIS, IND., U. S. A.

The New Ott 5"x18"

For a Bigger, Better Output of Straight or Taper Cylindrical Parts

THIS new Ott Grinder is particularly well adapted for the economical production of large quantities of small duplicate straight or taper cylindrical parts requiring close limits.

It has automatic feeds, Non-Gran bearings, massive wheel stand, head and foot stocks, large self-feeding oilers and adjustable universal back rest and Hyatt roller bearing countershaft.

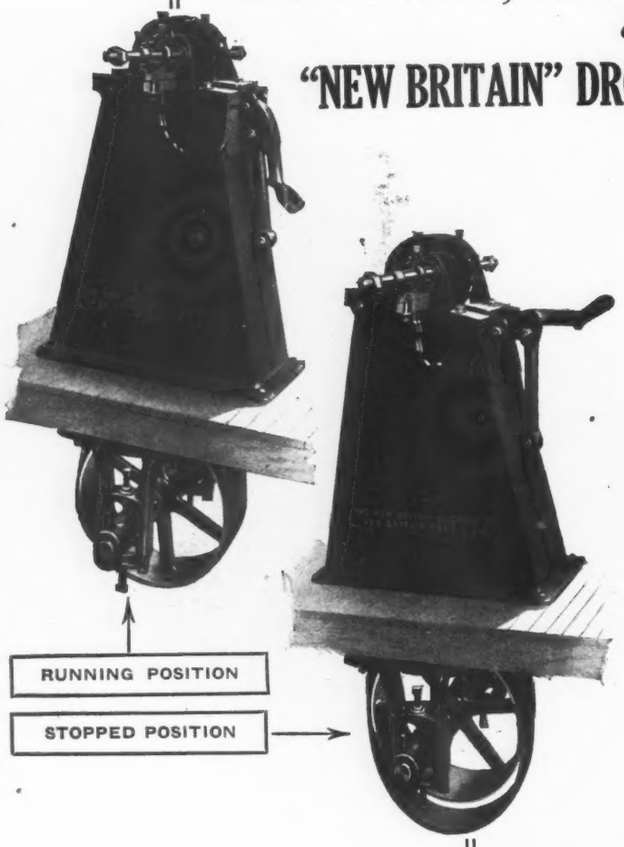
It is capable of handling a big percentage of work now being ground on larger and higher priced machines. It requires but 31" x 68" floor space and effects further savings in power, time and labor.

Get all the Details at Once

Less *Power*, Less *Floor Space*, Less *Care*

are required by

"NEW BRITAIN" DROP-HEAD POLISHING MACHINES



INCREASED cost and the difficulty of obtaining fuel are giving fresh impetus to the elimination of power losses. Demands for increased output call for plant enlargement, unless more efficient machinery is available. Labor shortage is directing the attention of factory managers toward those products which are designed with a view to time and labor-saving in their operation and upkeep.

The "New Britain" Drop-Head Polishing Machine, by reason of its elimination of idlers, loose pulleys, and shifting belts, very considerably reduces the power consumption. Twice as many of these machines can be installed in a given floor space as may be accommodated of the back-belted type. The enclosed belt, protected against dust, oil and moisture, and provided with means for tightening without shortening; self-aligning, self-oiling bearings; and the quick-starting quick-stopping feature, combine to make the "New Britain" a great time and labor saver.

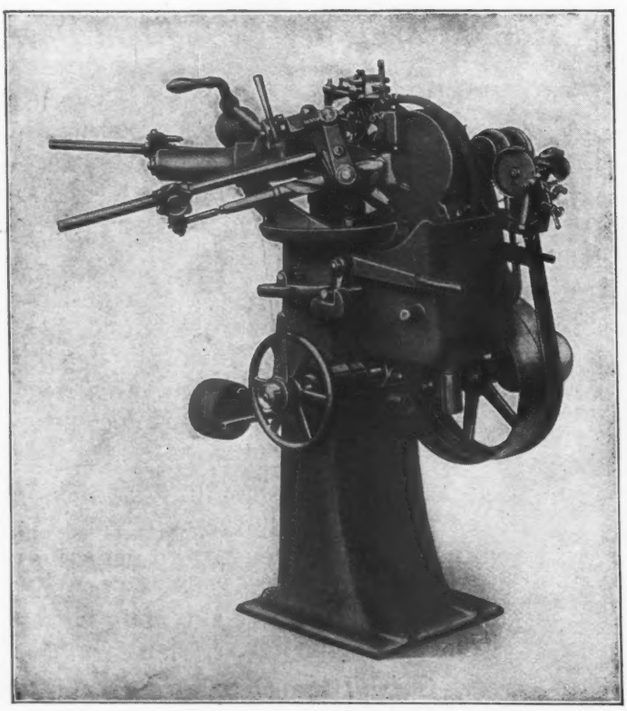
Made in floor and bench types, with either plain or ball bearings. Write for Bulletins No. 1225 and No. 1226.

"Built Like a Machine Tool"

The New Britain Machine Company

"Shop Furniture Originators" New Britain, Conn. U.S.A.

William Sellers & Co., Incorp. Philadelphia, Pa.



LABOR SAVING MACHINE TOOLS

If you want to reduce the cost of sharpening your drills, increase their output and improve their condition

Install a Sellers Drill Grinder in your tool-room

Drills correctly ground and pointed by it do much more work before regrinding, feed easier and cut faster than when sharpened in any other way.

It does not require a mechanic to grind a perfect drill. Operated by a boy or handy man, it will soon pay for itself in the decreased cost of sharpening, to say nothing of the improved condition of your drills.

Shafting—Injectors
Tool Grinding Machines

Back of Vitrified Wheels

is the knowledge that comes from long experience in selecting and grading abrasives, compounding bonding mixtures and proportioning, forming and baking the wheels;

BUT—

Vitrified Wheel Service does not end there. Our knowledge and experience are always at your disposal. Our catalog is complete and contains much useful data; but don't hesitate to write us should you need further cooperation in selecting the wheel to meet your particular requirements.

VITRIFIED WHEEL CO.
WESTFIELD MASSACHUSETTS, U. S. A.



VITRIFIED



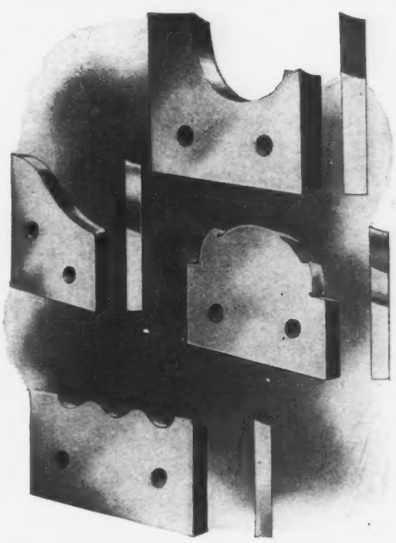
FISCHER PROFILE GRINDING MACHINES

Best Where Flat Irregular Shapes Are Ground



The Baldwin Locomotive Company uses 34 Fischer Profile Grinding Machines in one department. They are of great value in grinding practically any shape or contour and automatically providing the desired amount of clearance.

In producing exact duplicates in quantity they are unsurpassed for speed, accuracy and economy.

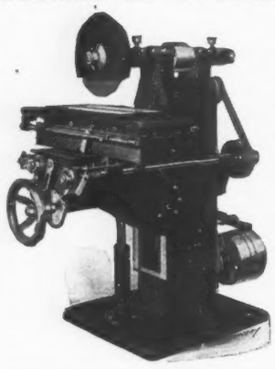


Let us send all the particulars.

FISCHER MACHINE COMPANY
PHILADELPHIA, PA.

DOMESTIC AGENTS: Charles A. Strelinger Co., Detroit, Mich. FOREIGN AGENTS: Coats Machine Tool Co., Ltd., Thanet House, Strand, London, Glasgow and Newcastle-on-Tyne. Aux Forges de Vulcain, Paris, France. Yamataka & Co., Tokio, Japan. Henry Coe & Clerici, Milan, Italy.

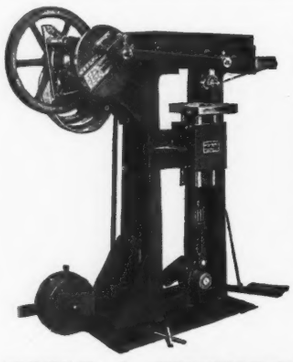
Noble & Westbrook Machines



For Finishing

This is the new Noble & Westbrook Automatic Surface Grinder. Working parts are thoroughly protected from abrasive dust. Simple adjustments. Feed screw dials are graduated to .001". Capacity 8" x 20".

See catalog on complete line of grinders and polishers.



For Marking

The Dwight Slate Marking Machine cuts a clean, permanent name or trademark in any material suitable for impressions. Catalog No. 5 contains list of prominent users.

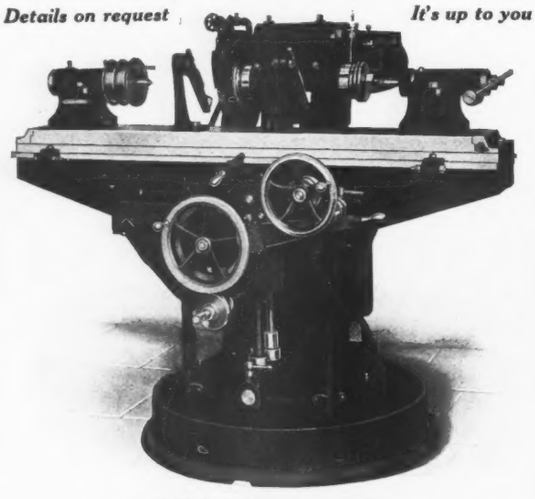
Complete steel lettering and die engraving department.

NOBLE & WESTBROOK MFG. COMPANY
19 ASYLUM STREET HARTFORD, CONNECTICUT

For Immediate Delivery
The Thompson Grinder

Consider the advantage of having this universal grinder added to your toolroom equipment "immediately." Designed on the stationary head principle, with rotating column and swivel table—quickly adjusted for any form of plain, surface, edge, die, cutter and internal grinding. An asset in any shop—a godsend to an overworked toolroom.

Details on request ***It's up to you***



Full description in catalog

THE THOMPSON GRINDER CO.
Springfield, Ohio, U. S. A.

EMERY WHEEL DRESSERS

No. 0 For Small Wheels **No. 2 For Large Wheels**



NO. 1 FOR REGULAR SHOP USE

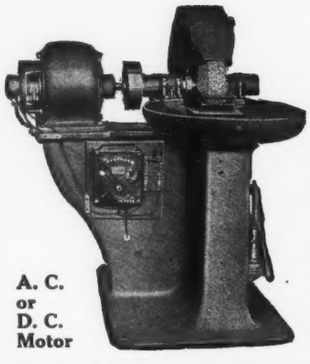
These Dressers in connection with our Cutters make a most powerful and efficient tool, especially our No. 0 for small wheels 6 inches and under, and No. 2 which is made proportionately larger and stronger for large wheels.

CUTTERS

We make the regular "Huntington" (pattern) for No. 0 and "Huntington" (pattern) Paragon Cutter and Roughing Cutter for Dresser No. 1 and the "Huntington" (pattern) and Roughing Cutters for Dresser No. 2. Let us send you descriptive circular and prices.

GEO. H. CALDER, Lancaster, Pa., U. S. A.

Bridgeport Belt and Motor Driven Grinders



A. C. or D. C. Motor

—wet, dry or combination of both—cup, ring wheel, knife, etc.—meet all tool room requirements.

This Motor Driven Wet Tool Grinder is rigid, well balanced, made in five sizes, for 14 to 42 inch wheels—as pictured or with drop bowl for grinding long tools.

Write us

THE BRIDGEPORT SAFETY EMERY WHEEL CO., INC.
Bridgeport Conn., U. S. A.

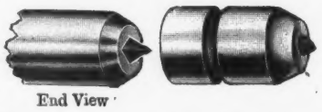
THE WATERBURY GRINDER



Strong, speedy, accurate, economical, durable — more adjectives *could* be used, but it is simpler to say—dependable—for the Waterbury Grinder is just that. A *dependable* machine for tool or surface grinding and a genuine economy in the shop.

Circular ?

The Blake & Johnson Co.
WATERBURY, CONN., U. S. A.



End View

FRANCIS

Diamond Grinder Tools

for truing emery and carborundum wheels are giving great satisfaction everywhere because of the hard and high quality diamonds used. They will keep your abrasive wheels in good cutting condition.

Ask for descriptive circular and let us send you an assortment for selection.

FRANCIS & CO.

50 State St., Hartford, Conn., U. S. A.
Established in 1799. First National Bank Bldg.



End View

The Price of Diamonds

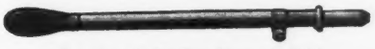
for dressing Grinding Wheels is becoming almost prohibitive.

DESMOND-STEPHAN MFG. CO. GRINDING WHEEL DRESSERS URBANA OHIO

DIAMO-CARBO
Emery Wheel Dressers

are an inexpensive and effective substitute for the black diamond—and will do the same work at a price that permits a dresser for each wheel. Wearing qualities are unsurpassed, upkeep is nil and there is a decided saving from all standpoints.

Will you try one at our expense?



No. 3—10 inches long, $3.50



No. 5—12 inches long, $4.00

THE DESMOND-STEPHAN MFG CO.
URBANA OHIO, U. S. A.

Alfred Herbert, Ltd., Coventry, Agents for Great Britain. The Canadian Desmond-Stephan Mfg. Co., Ltd., Hamilton, Ont., distributors for Canada.

PRODUCTION

SURFACE GRINDER



Adjustable Taper Spindle
All Surfaces Hand Scraped
Graduated Feeds

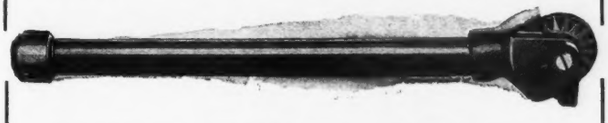
Surface of Platen 15 x 5 in.
Traverse Movement 8 in.
Vertical Movement 9 in.
Stone 6 x ½ x ½ in.
Speed of c/shaft 400 r. p. m.
Weight 435 lbs.

$150.00

Write for Catalog.

New Jersey Machinery Exchange
Newark New Jersey, U. S. A.

NEW SELF-LUBRICATING



EMERY WHEEL DRESSER and CUTTERS

"We have found it the most economical and efficient device we have used for the purpose."
THE FAVORITE STOVE AND RANGE CO.,
Piqua, Ohio.

THE HETHERINGTON CO., Piqua, Ohio
Geo. W. Goodchild & MacNab, London, Eng., Agents for Great Britain

RANSOM GRINDERS

Motor driven, they save power, cost and upkeep of transmission equipment and are readily installed or relocated.

No. 48, for extra heavy duty, is of massive proportions. High carbon steel arbor, with ring oiling, dust proof boxes, maintains true alignment, and our Patent Speed Controller prevents wheels over-speeding. Ideal for steel foundry work and similar severe service—a well liked model of a popular line.

Complete Catalog on Request



No. 48

RANSOM MANUFACTURING CO.
OSHKOSH WISCONSIN, U. S. A.

TELL US WHAT YOU GRIND

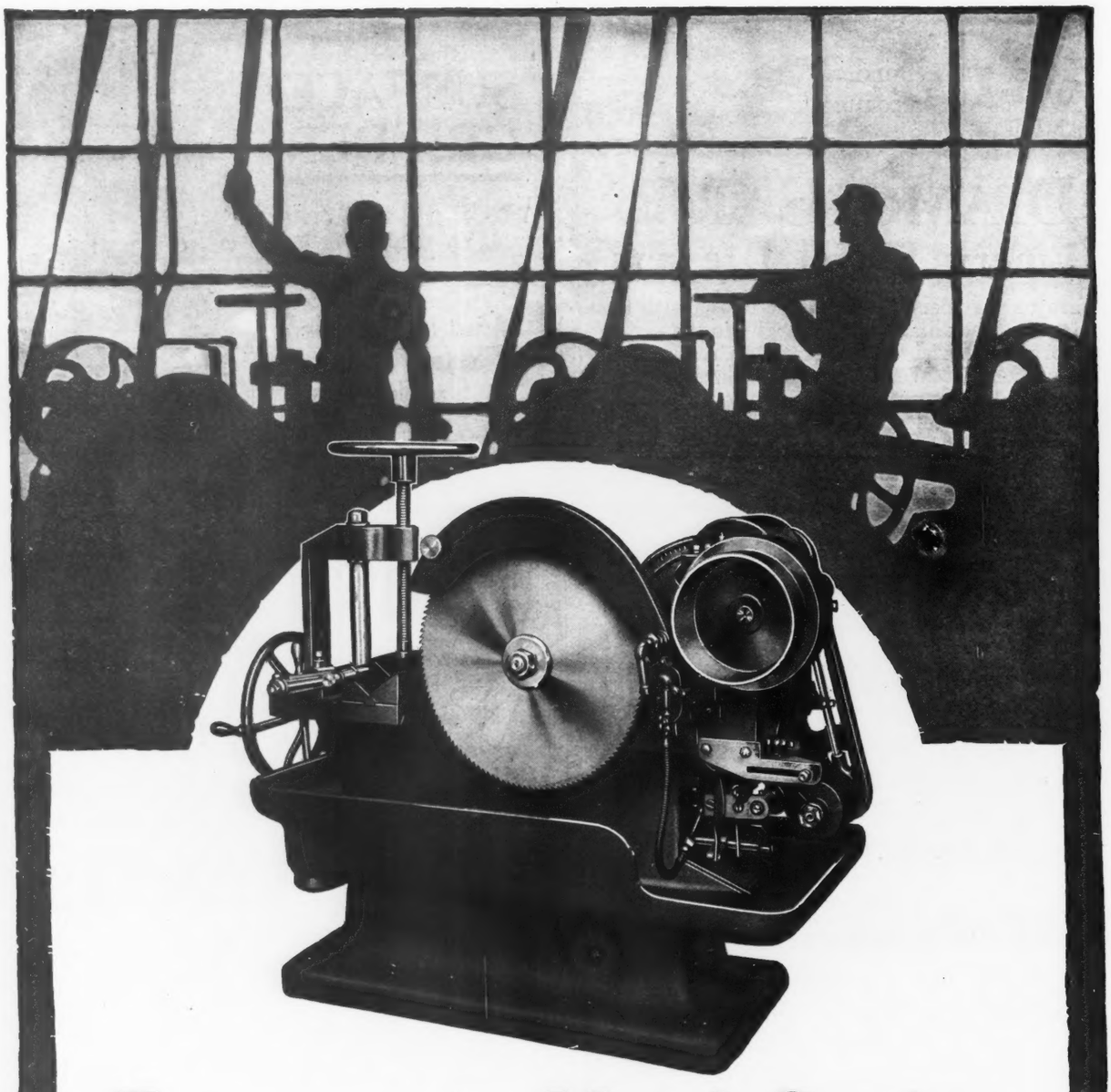
and we'll pick the wheel that will do your work to best advantage—



A STERLING Grinding Wheel
fast, free-cutting and economical of power. *Catalog?*

THE STERLING GRINDING WHEEL COMPANY, TIFFIN OHIO

Selling Agency:
L. Best Company,
75 Barclay St., New York,
Chicago Store:
30 North Clinton St.



Economy in Metal Cutting

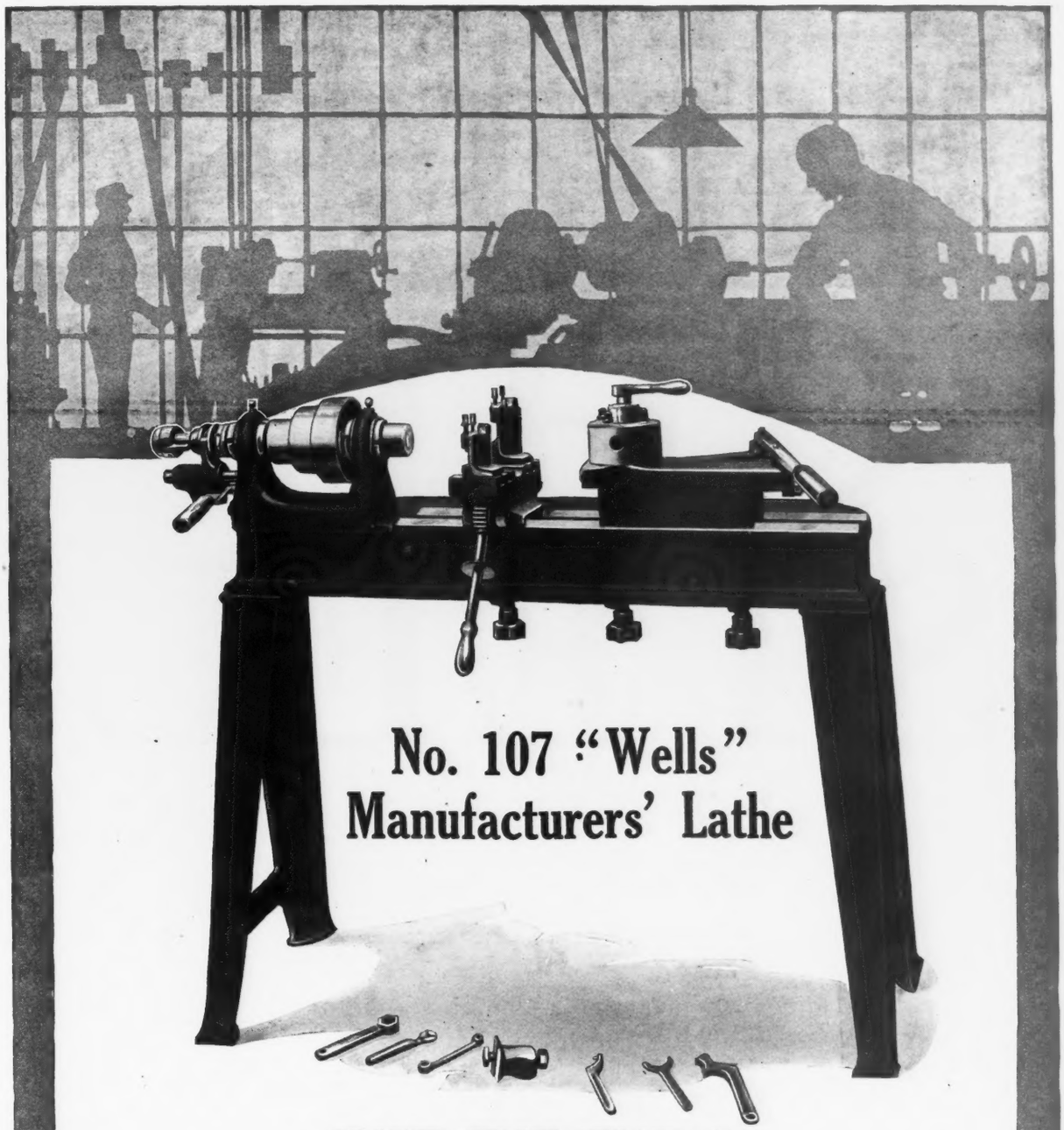
is accomplished by using Nutter and Barnes Cutting Off machines. They are strong, high powered, speedy and easily controlled. Special features are—single lever control for stopping and starting feed, four speed changes, a system for forced lubrication which always delivers the oil at the cutting point and a friction safety device to prevent overfeeding.

Machine Tool Division

Greenfield Tap and Die Corporation

GREENFIELD MASSACHUSETTS, U. S. A.

REG. U.S. PAT. OFF. G T D



No. 107 "Wells" Manufacturers' Lathe

JUST THE THING!

Solves the problem of employing unskilled labor for turning out quantities of small brass parts.

The hand turret and cross carriage permit the completion of several operations without removing the parts. The stock is fed by a hand lever. There is nothing to get out of order.

It is easily operated—a very important feature where women are employed.

Write for Particulars and New Machine Tool Catalog No. 39.

MACHINE TOOL DIVISION

Greenfield Tap and Die Corporation

GREENFIELD MASSACHUSETTS, U. S. A.

49

BLUE CHIP STEEL

We've tried to make our advertising carry the conviction that Blue Chip High Speed Steel is uniform, dependable steel. If it does carry that conviction it has accomplished its purpose.

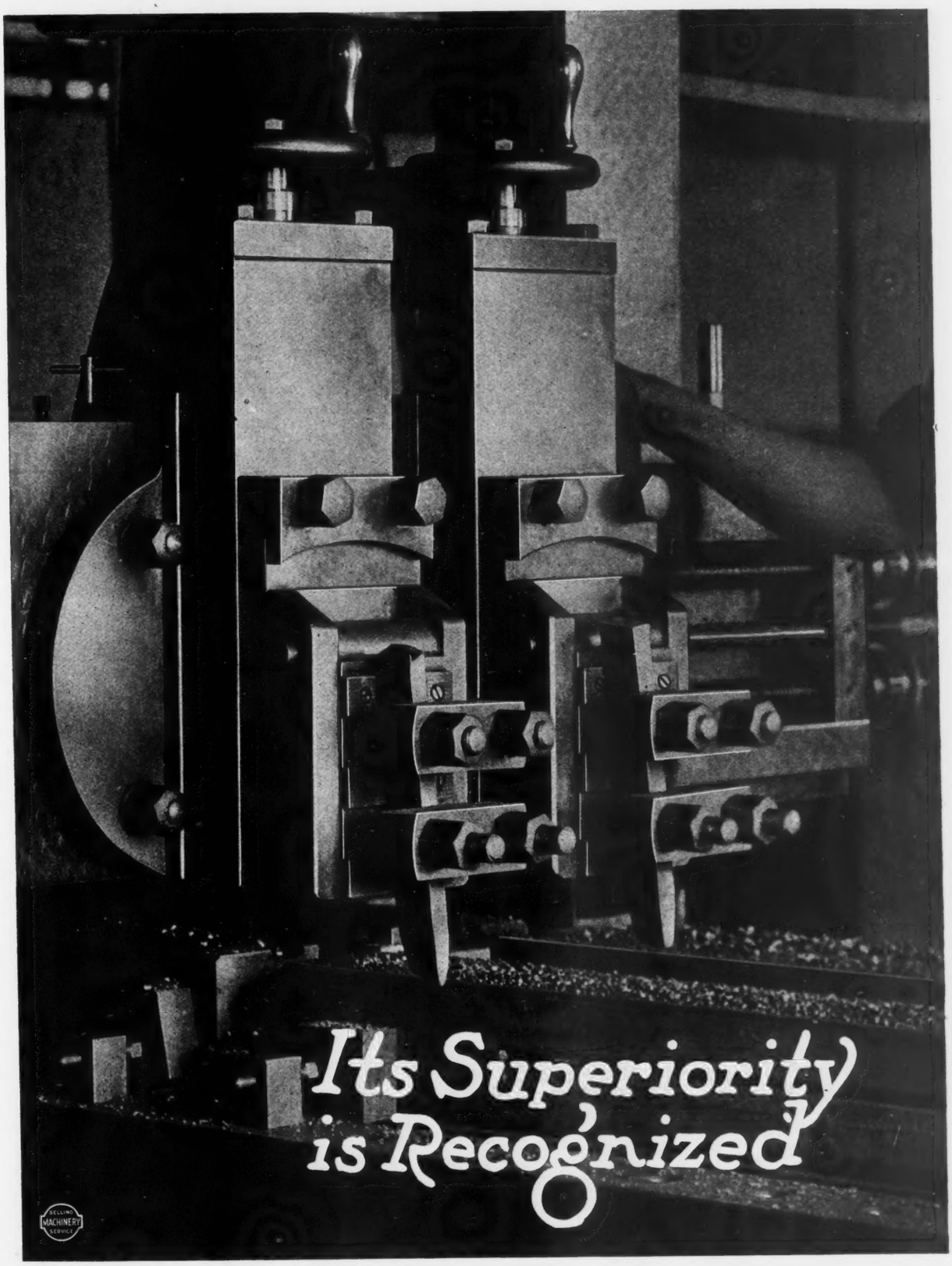
Blue Chip Steel needs no recommending in the plants where it is known. For years it has been used by concerns we all look upon as leaders—used for making all manner of cutting tools and to meet greatly varied requirements. And it has made good.

Give Blue Chip High Speed Steel the opportunity to convince you of its superiority. Write for more details.

FIRTH-STERLING STEEL CO.

McKEESPORT, PA., U. S. A.

BOSTON NEW YORK PHILADELPHIA CHICAGO CLEVELAND PITTSBURGH


Its Superiority
is Recognized
SELLING
MACHINERY
SERVICE


REG. U.S. PAT. OFF.
Tycos
ROCHESTER, N.Y.
Taylor Instrument Companies
ROCHESTER, N.Y.
HUNDREDS FAHRENHEIT
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18
Tycos PYROMETER
ZERO ADJUSTMENT
TYCOS
PYROMETERS
Preferred
Investments
AVAIL YOURSELF OF OUR CATALOGS
AND INFORMATION
The Taylor-Cambridge Division
Taylor Instrument Companies
Rochester, N.Y.

BOEHM DIE HEAD

Threads Sixty of These Brass Valve Stems Per Hour



Brass castings become gage valve stems at the rate of one a minute in the Hays Manufacturing Company shops, Erie, Pa. In this accomplishment the Boehm Die Head is exceeding the expectations of its owners. Threads are two inches long, six pitch, Acme, and are completed in one cut.

The Boehm Die Head is well made to "make good" under all conditions.

The Boehm Die Head found its stride in this concern more than two years ago and has stuck to it ever since. The scrap heap, conspicuous by its absence, makes this speed still more remarkable. Speed with precision is the Boehm characteristic.

The uniform method of securely holding the chasers makes for exact duplication. There's sound principle in the design; few parts in the construction. It is simple, accessible and economical.

Put a Boehm Die Head on your machine. It's a practical spur to laggard production. Do it now.

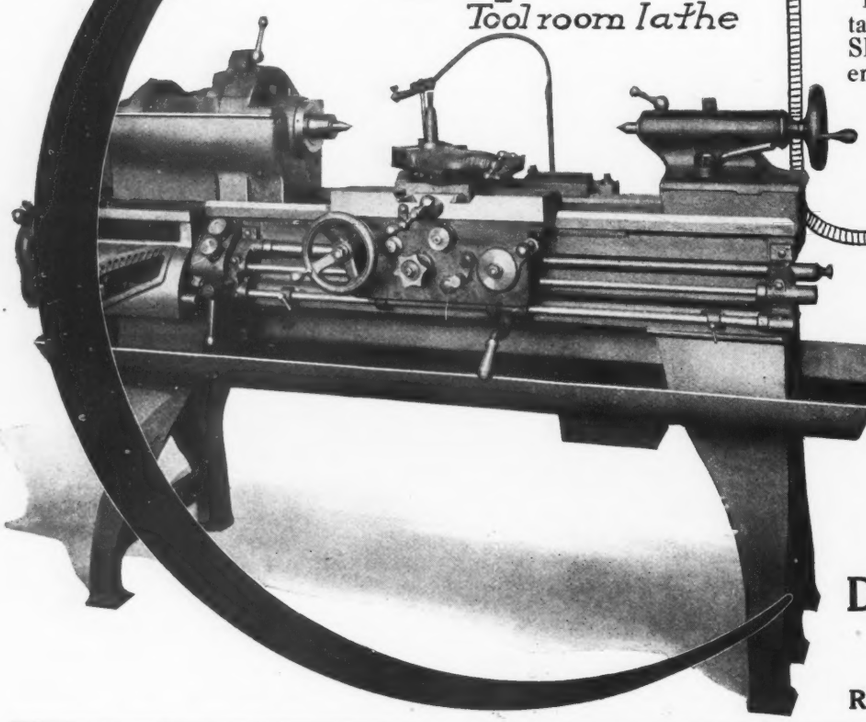
RICKERT-SHAFER CO., 612 W. 12th St., ERIE, PA.

New York Office: 50 Church Street

DAVIS

Close Coupled

Tool room lathe



THREE point support for a machine is a feature of importance in assuring rigidity and accurate alignment under varying working conditions. It is a distinctive feature of this 14¼ inch "Davis"—which also boasts taper spindle bearings, with SKF self-aligning ball bearing end thrust, reverse mechanism and automatic stop (contained in one rod) and other points equally interesting to discriminating manufacturers.

Hole in Spindle 1½"
Cone Diameter 4" to 9"
Cuts Threads 1½ to 80

Complete description on request

DAVIS MACHINE TOOL CO., Inc.

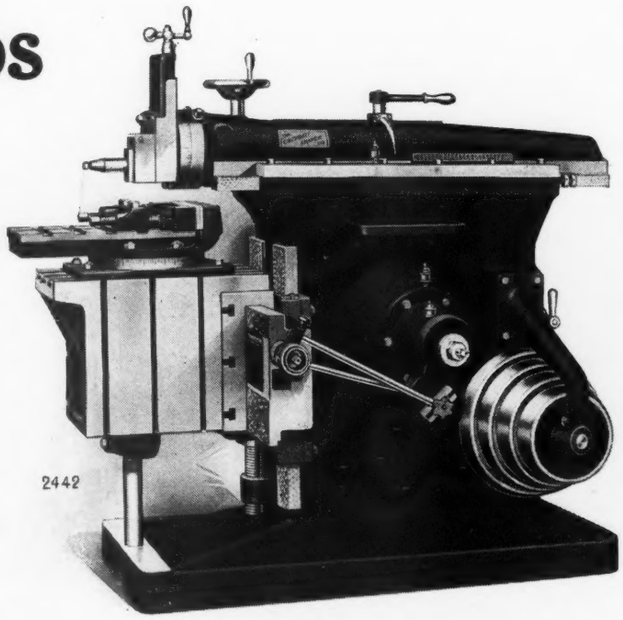
ROCHESTER, N. Y. U. S. A.

Tapered Gibs

Giving full length metal contact.

Endwise adjustable by single screw.

Our gibs do not rest on points of set screws, but flat against a solid bearing giving practically a solid metal contact.



Our Heavy Duty Shapers also have many other excellent features. Ask for our new Catalog J.

THE CINCINNATI SHAPER COMPANY

CINCINNATI, OHIO, U. S. A.

Our Improved

Gear Tooth Rounding Machine

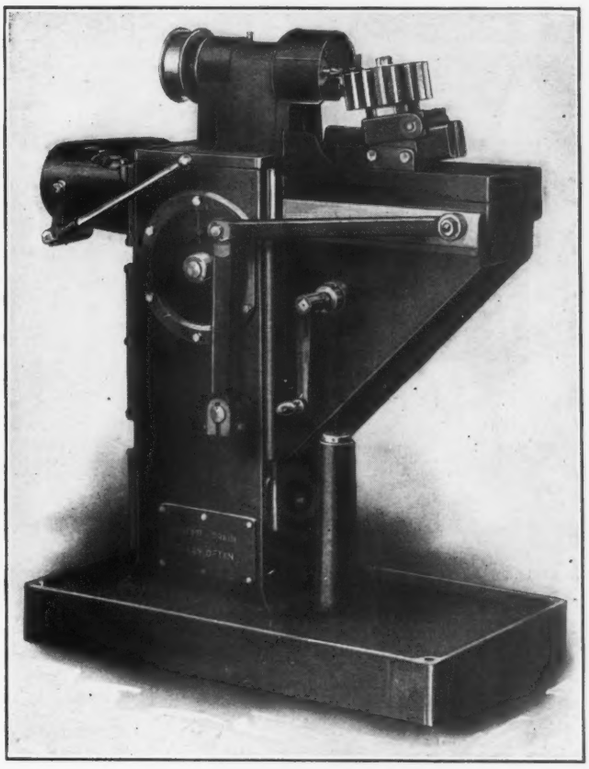
Is Quick, Accurate and Convenient

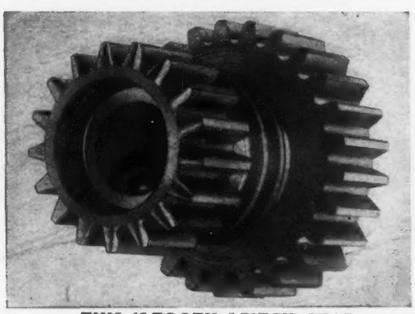
For rounding sliding gear teeth our new improved Gear Tooth Rounding Machine has no equal. It is fast, accurate and convenient.

Makers of machine tools, automobiles, tractors, etc., and gear contractors will find it an unusually profitable investment.

Anyone can operate it. It has few parts and is durably constructed for long, steady usage. It occupies but little floor space.

It has a capacity for any pitch from 2½ to 20; gears up to 30 inch diameter by 12 inch face.





THIS 17-TOOTH 5-PITCH GEAR
ROUNDED IN 1 MINUTE 8 SECONDS
FLOOR TO FLOOR TIME

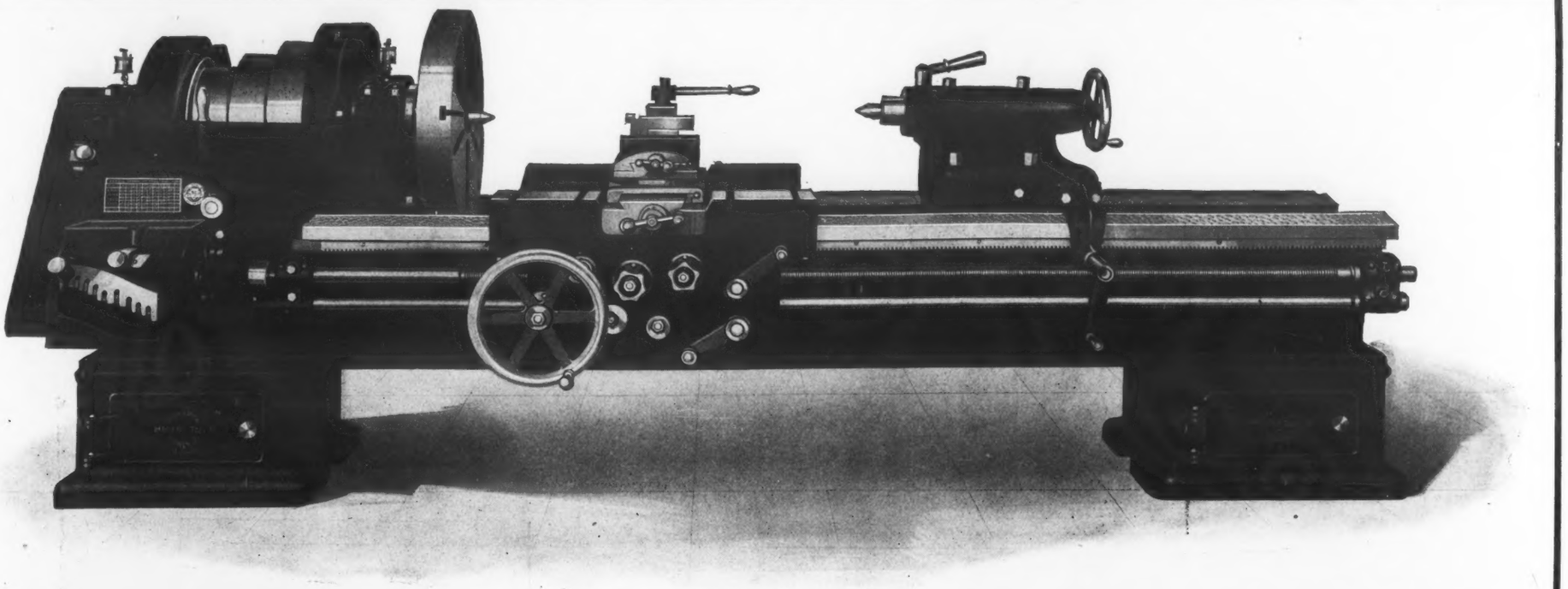
Here is Its Production Record

This machine will round 27 6-pitch chrome nickel gear teeth in one minute, other pitches at proportionately good speeds.

Let us send you further particulars. Write at once to insure early delivery.

CHAS. H. WALKER MACHINERY CO.

42-44 East Larned Street **DETROIT, MICH., U. S. A.**



MONARCH *24", 26", 28" and 30"* LATHES

Illustration above shows 24" x 12' lathe with quick change gears and double back gears.

Swing over shears 24¼".
Hole through spindle 2⅛".
Front spindle bearing 4⅝" x 7 3/16".
Back spindle bearing 3 x 4⅞".
Diameter pulleys 11, 14, 17".
Width belt 4½".
Width carriage bridge 10½".
Length carriage bearing on bed 34".
Diameter tail spindle 3⅜".
Countershaft equipped complete with Hyatt roller bearings; size pulleys 18" x 6".
Weight 8500 lbs.

Consult the Monarch Dealer nearest you regarding delivery and prices. Catalog on request.

THE MONARCH MACHINE TOOL CO.

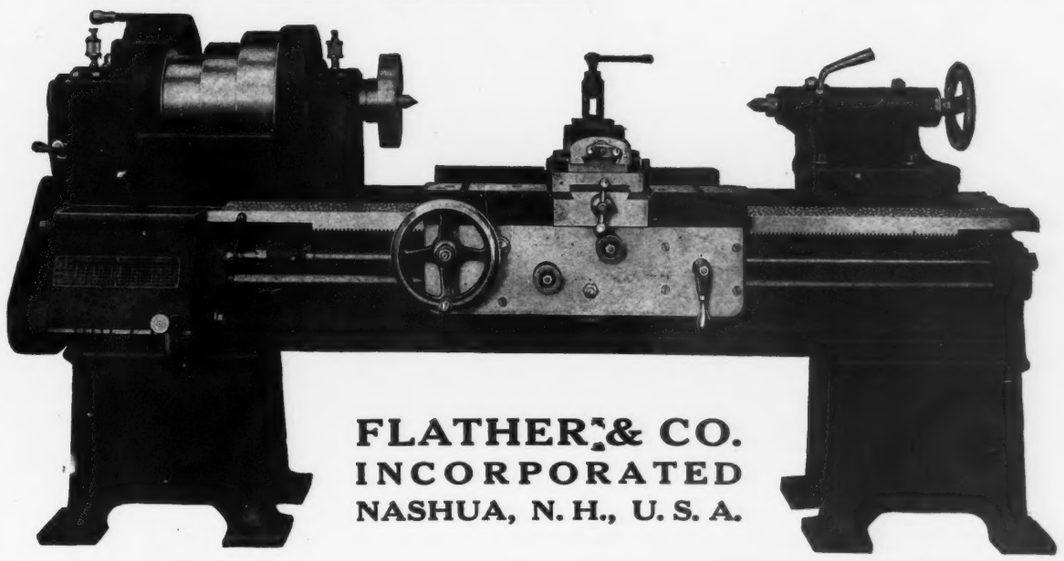
SIDNEY OHIO U. S. A.

DOMESTIC AGENTS: Lynd-Farquhar Co., Boston, Mass. Brownell Machinery Co., Providence, R. I. Purinton & Smith Co., Hartford, Conn. Kemp Machinery Co., Baltimore Md. Vandyck Churchill Co., New York City, N. Y. Morris Machinery Co., Newark, N. J. Syracuse Supply Co., Syracuse, Buffalo and Rochester. Simmons Machine Co., Albany, N. Y. Monarch Machinery Co., Philadelphia, Pa. J. S. Miller Machinery Co., Pittsburgh, Pa. W. M. Pattison Supply Co., Cleveland, O. Coghlin Machinery & Supply Co., Toledo, O. Patterson Tool & Supply Co., Dayton, O. Osborne & Sexton Machinery Co., Columbus, O. Vonnegut Machinery Co., Indianapolis, Ind. Greensboro Supply Co., Greensboro, N. C. Oliver H. Van Horn Co., New Orleans, La. Charles A. Strelinger Co., Detroit, Mich. McMullen Machinery Co., Grand Rapids, Mich. Federal Machinery Sales Co., Chicago, Ill. Badger Packard Machinery Co., Milwaukee, Wis. Northern Machinery Co., Minneapolis, Minn. Colcord Wright Machinery & Supply Co., St. Louis, Mo. English Tool & Supply Co., Kansas City, Mo. Sunderland Machinery & Supply Co., Omaha, Neb. Hendrie & Bolthoff Mfg. & Supply Co., Denver, Colo. Salt Lake Hdwe. Co., Salt Lake City, Utah. General Machinery Co., Spokane. Hallidie Machinery Co., Seattle. Eccles & Smith Co., Portland, San Francisco and Los Angeles.

"There's Something in a Name!"

FLATHER

This 20″ Double Back Geared Lathe possesses every feature for quantity, quality and economical production. Sound principles and special characteristics are built into every Flather Lathe. Send for the catalog.

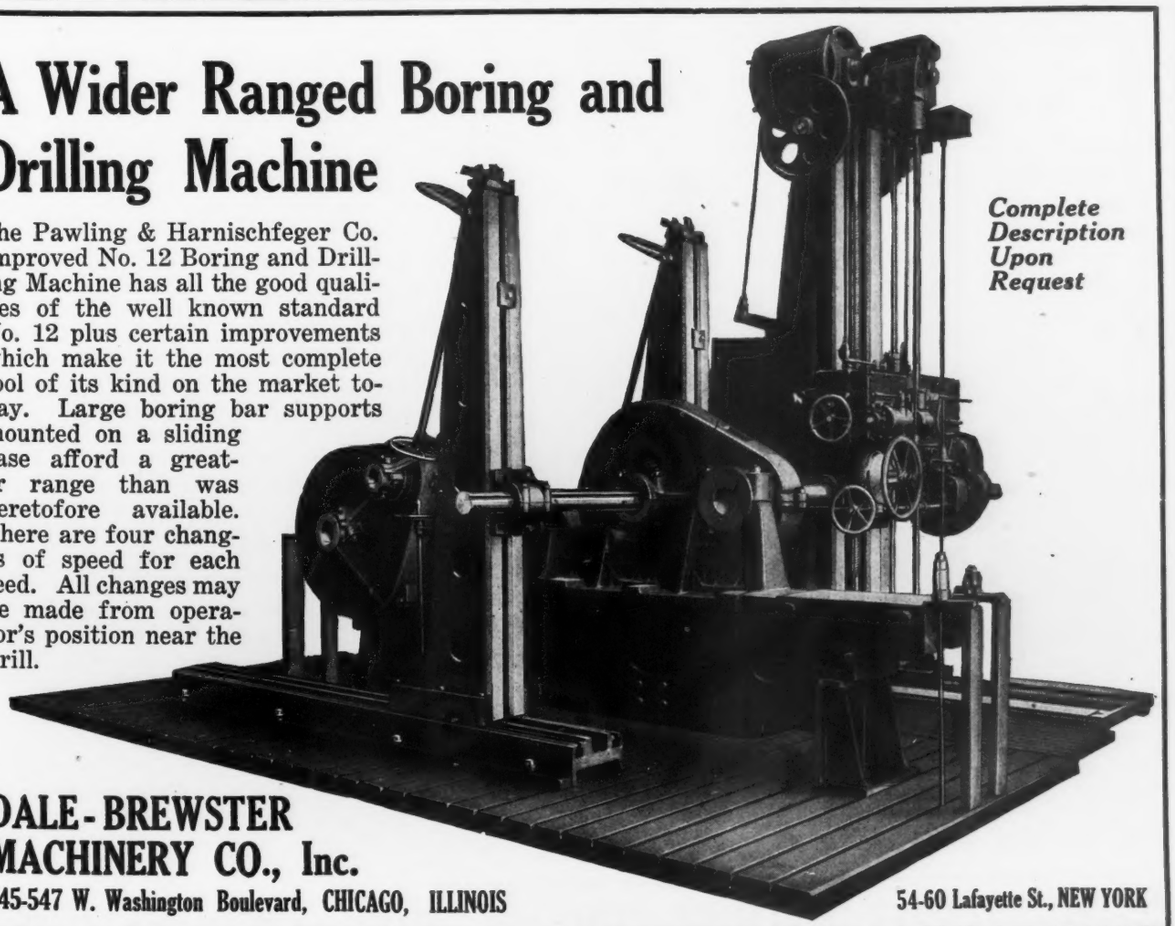


FLATHER & CO.
INCORPORATED
NASHUA, N. H., U. S. A.

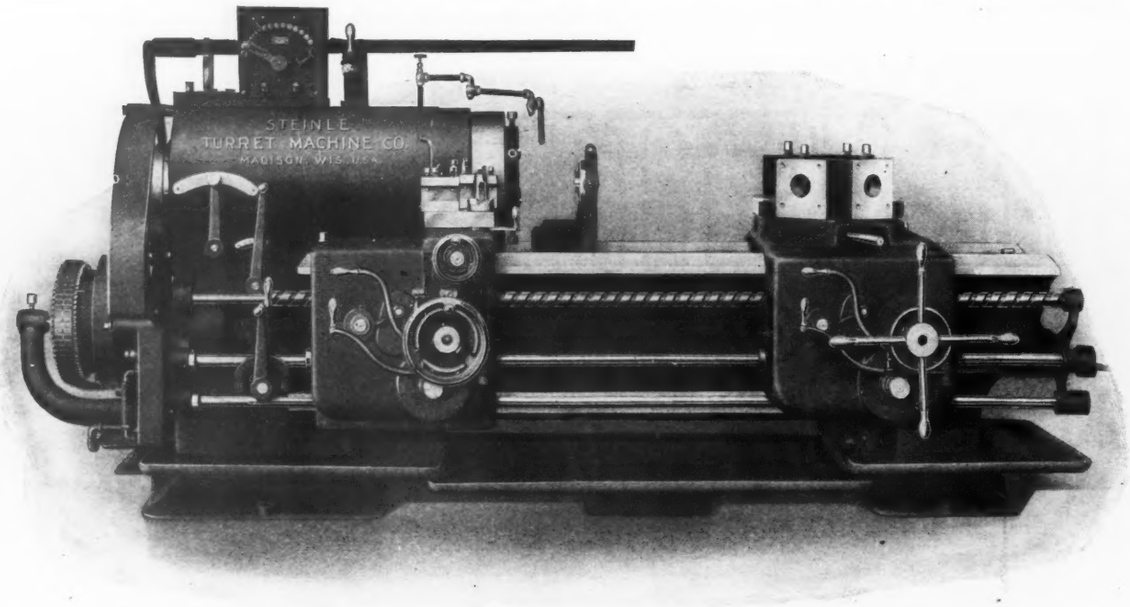
A Wider Ranged Boring and Drilling Machine

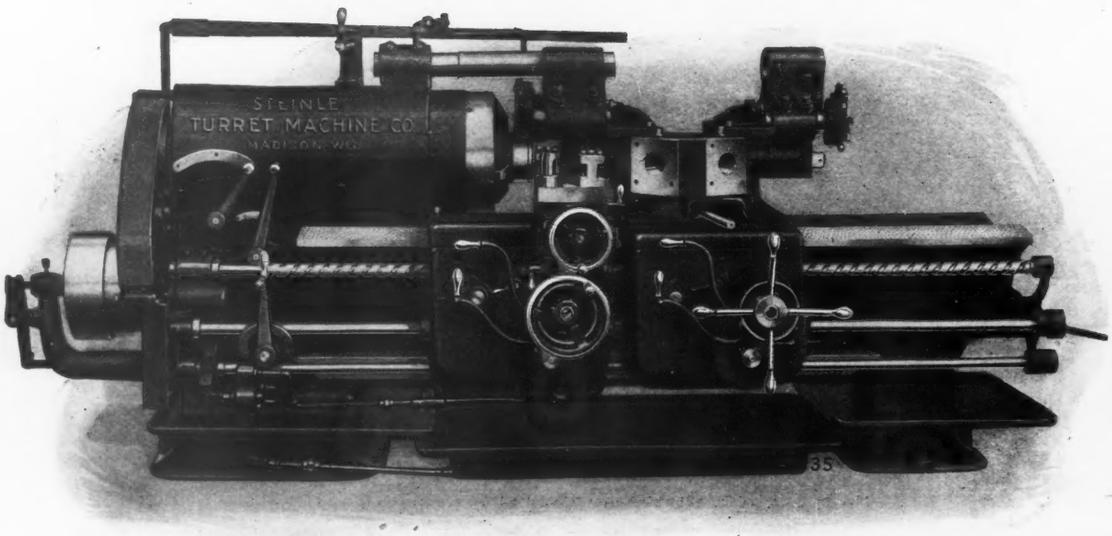
The Pawling & Harnischfeger Co. Improved No. 12 Boring and Drilling Machine has all the good qualities of the well known standard No. 12 plus certain improvements which make it the most complete tool of its kind on the market today. Large boring bar supports mounted on a sliding base afford a greater range than was heretofore available. There are four changes of speed for each feed. All changes may be made from operator's position near the drill.

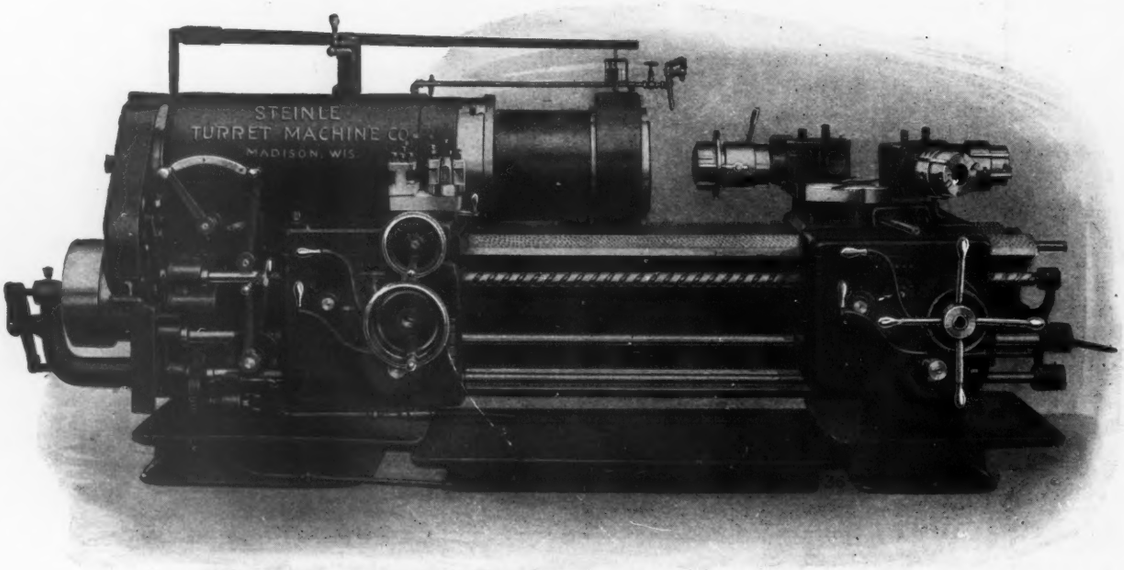
Complete Description Upon Request



DALE-BREWSTER MACHINERY CO., Inc.
545-547 W. Washington Boulevard, CHICAGO, ILLINOIS
54-60 Lafayette St., NEW YORK







WRITE FOR INFORMATION

STEINLE TURRET MACHINE COMPANY, Madison, Wisconsin, U. S. A.

CLEVELAND

20" Heavy Duty Motor Driven Engine Lathe

THE Cleveland 20″ Heavy Duty Motor Driven Engine Lathe performs an invaluable service in heavy manufacturing shops and busy shops in general. Its specialty is turning out a maximum amount of heavy work under pressure.

It is rigidly reinforced without becoming cumbersome, has all controls convenient to operator, and may be relied upon at all times for its readiness and accuracy.

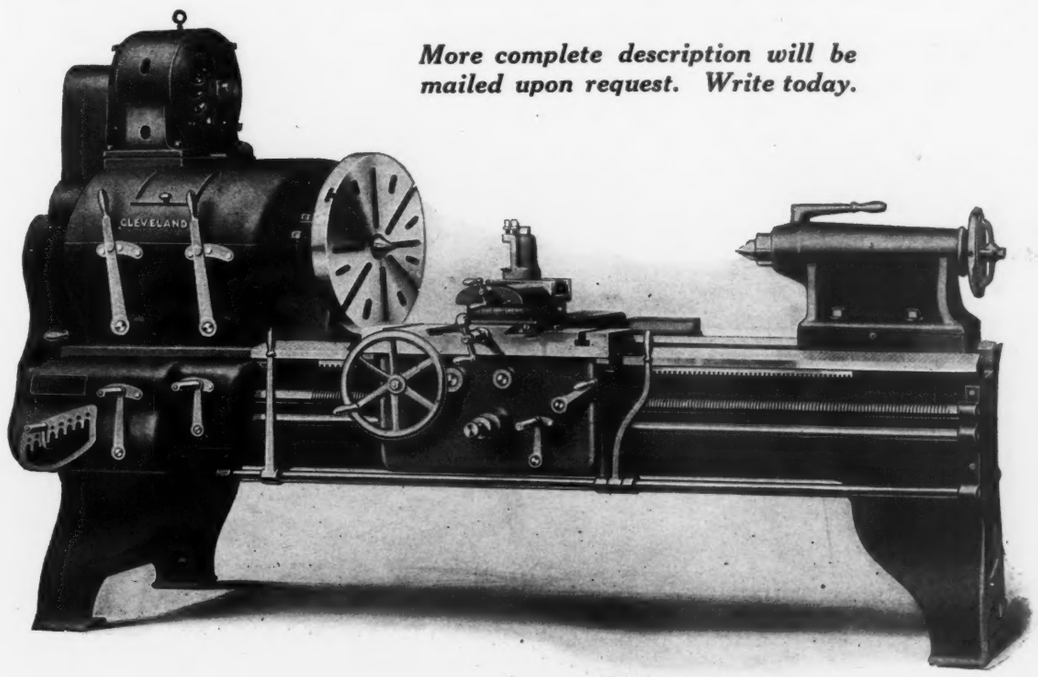
Cleveland 20" Heavy Duty Motor Driven Engine Lathe

It has an unusually wide and deep bed with numerous box section ribs, compensating vee in front and flat way in rear for carriage.

Geared headstock of improved construction affords nine quickly available speeds by the operation of two levers.

Apron is of double wall construction; carriage is extremely large and heavy. Many other features are worthy of your prompt consideration.

More complete description will be mailed upon request. Write today.



The Cleveland Machinery & Supply Co.

General Offices: **Cleveland, Ohio**

Factories: **Hamilton, Ohio** **Columbus, Ohio** **Richmond, Ind.**

DISCOVERED
An AMES LATHE
on a
"Reel" Peaceful Job

B.C. AMES CO. WALTHAM MASS. U.S.A.

B. C. AMES COMPANY
Waltham, Mass.

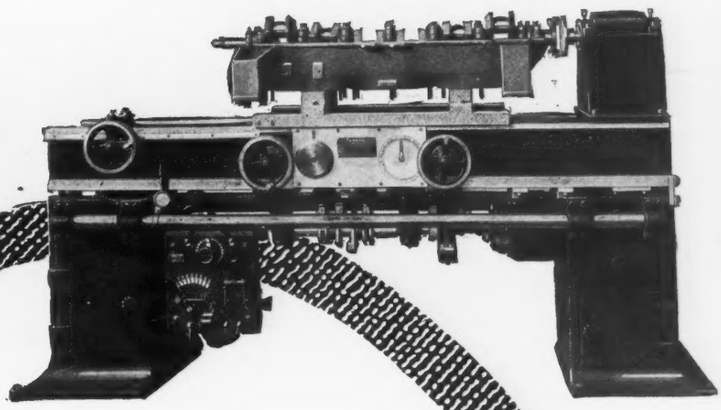
SMALL as they are, Ames Lathes are contributing in no unimportant way to the maintenance of the sinews of war. We have seen them in many shops, producing accurate ammunition dies and handling similar work for the cause.

But not all the Ames Lathes have been commandeered to help in the foremost business of the day—the one in the photograph, for instance, works in the Horton Manufacturing Company's plant at Bristol, Conn., on a "reel" peaceful job. It is making fishing reel parts, and the reputation of the company behind it is sufficient testimony for the reliability of the product.

Have *you* a light manufacturing job about which you are particular? Better consult the Ames catalogue at once.



IF YOU HAD THIS MACHINE



you could turn out a much smoother running product and do it quicker and cheaper.

If you have never felt justified in going to the expense of accurately balancing the rotating parts of your product or have depended on the old tedious cut-and-try method you will immediately appreciate the importance of the

CARWEN

Dynamic Balancing Machine

(Akimoff Patents)

After obtaining the static balance of a crankshaft, place it in the Carwen and while it is rotating you can measure accurately the correction needed to secure true running balance. By applying the dial reading to the chart you can determine just how much and where to take off (or add to) so as to eliminate vibration.

The entire operation takes less than five minutes, and the vastly improved running qualities obtained are even more important than the time saved.

We make these machines in sizes suitable for balancing objects weighing from 5 oz. up to 15,000 lbs. and their use is just as practical on medium quality products as on those where price does not enter into consideration.

We will gladly make a demonstration without cost.

The Carlson-Wenstrom Co.

Erie Avenue at Richmond Street

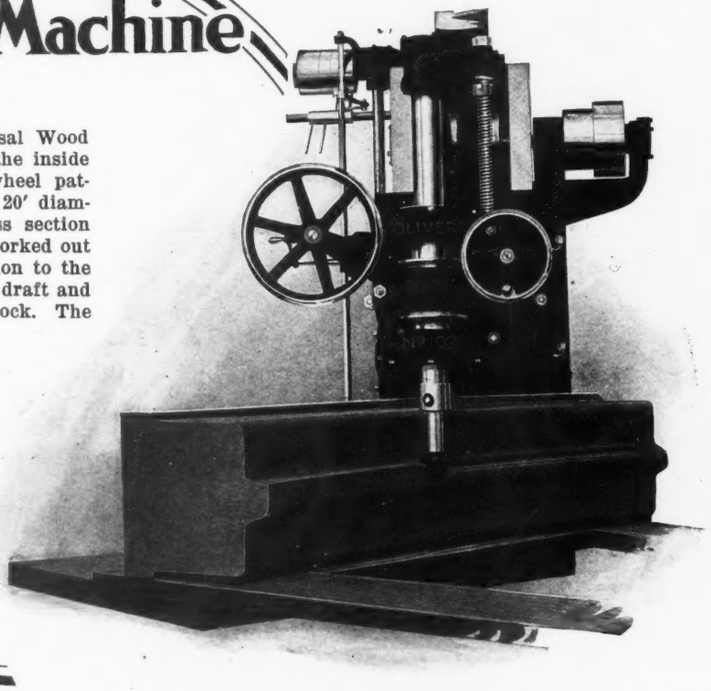
Philadelphia, Pa.

Illustrated Booklet describing the principle involved and its application sent upon request

Makers also of CARWEN Double Row Ball Bearings

OLIVER
Wood Milling Machine

Don't think because you used to dig out your pattern work by hand methods that you need to continue to do it now.



Cut shows No. 102 Universal Wood Milling Machine finishing the inside of heavy segment of fly wheel pattern. It is a 6′ section of 20′ diameter fly wheel with a cross section 14½″ by 15½″. This was worked out of the rough glued up section to the true circle and with proper draft and fillet cut out of the solid stock. The ends were squared off true to the correct angle.

Time 8 hours.
Figure the saving.

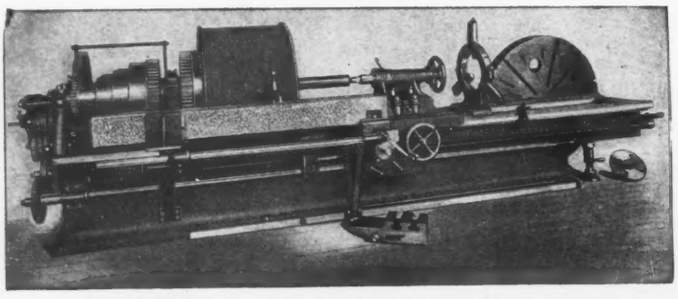
Send for descriptive literature.

Oliver Machinery Co.
Grand Rapids, Mich.

It will handle all of your work with every convenience—

and can be kept busy every hour of the day owing to the great range and adaptability—

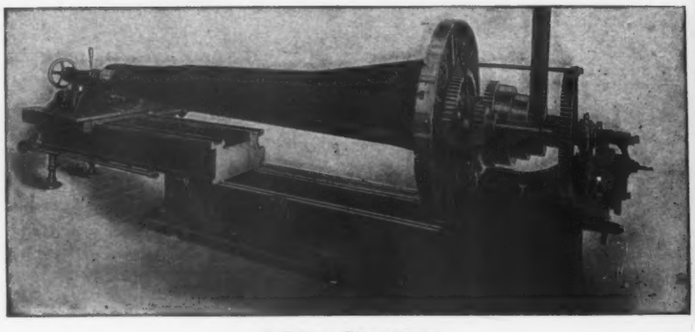
The Harrington Extension Bed Gap Lathe



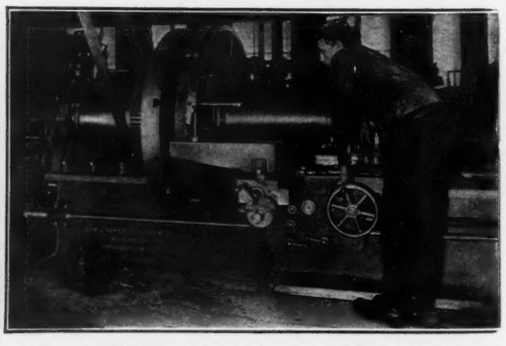
Extension Attachment for turning long distances across the gap

The bed is made in two parts, the upper arranged to slide on the lower, so that the length of the gap can be varied or the distance between centers nearly doubled. No time is lost while the operation is going on, and no rigidity or accuracy is sacrificed.

Edwin Harrington, Son & Co., Inc., Philadelphia, Pa.



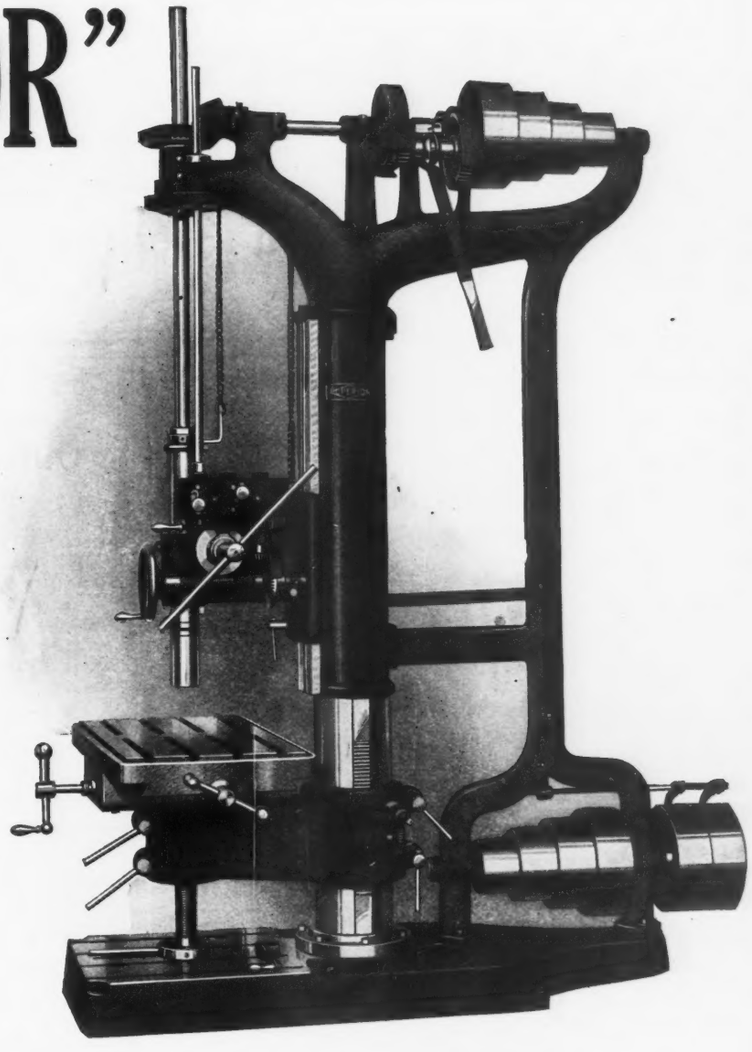
A Job on Long Centers



Extension Tool Block for turning short distances over the gap

"SUPERIOR"

Sliding Head Vertical Drilling Machines



Built in 25", 28", 32" and 36" Sizes

Here's a line of drilling machines, designed for manufacturing and jobbing purposes, in which many refinements of design and construction, not found in the average standard machine, have been incorporated. Particular attention has been given to accuracy and alignments; adjustable automatic stop reduces drill breakage to a minimum; bearings on column are extra long and the table is rigidly supported.

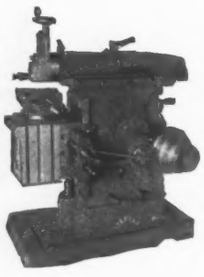
Friction Tapping Attachment and Special Compound Table broaden the range of these machines, and their convenience and adaptability reduce the cost of even the simplest operation to a minimum. Material and workmanship are fully guaranteed and each machine is thoroughly tested under its own belt before shipment.

Complete description and specifications of these wide range machines sent on request.

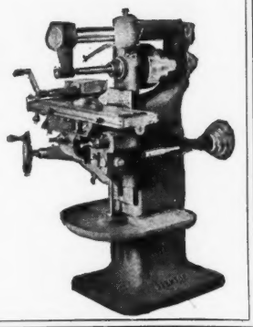
THE SUPERIOR MACHINE TOOL CO.

KOKOMO, INDIANA, U. S. A.

Steptoe Shapers and Milling Machines



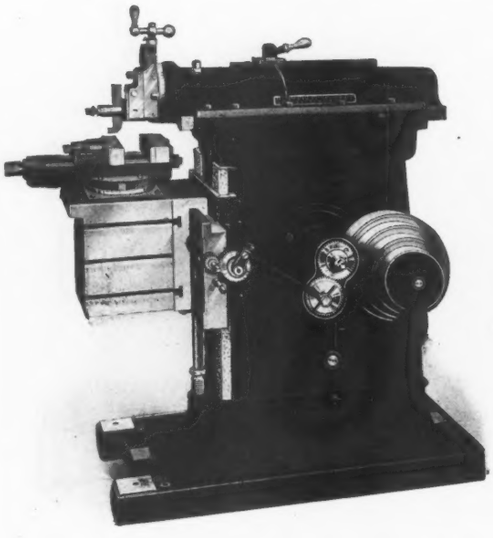
Represent seventy-three years of experience in the manufacture of high grade machine tools and thousands of our machines are in shops giving daily satisfaction.



The John Steptoe Company
BRIGHTON **CINCINNATI, OHIO**

WE CONFINE OURSELVES TO BUILDING

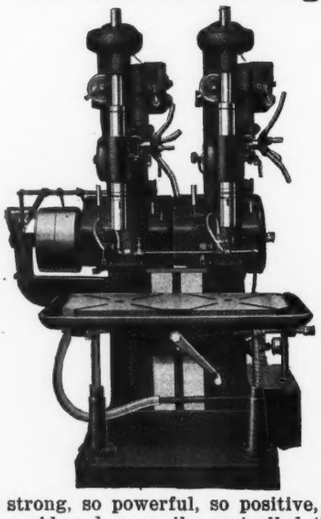
Shapers Exclusively



Crank Sizes: 12, 14, 16, 20, 25, 28 and 32 inch
Geared Sizes: 28, 32 inch

Smith & Mills Company
CINCINNATI **OHIO, U. S. A.**

Save Labor by Using the Self-Oiling All Geared Gang Drill



It is so strong, so powerful, so positive, so accurate, so rapid and so easily controlled that your operators will turn out more work of a better character than they can accomplish on any drill having cone and inherent belts to shift, to slip, to give trouble, waste time and make expense. Our Self Oiler offers you *Maximum Value* in a drilling machine. It is unequaled in power, speed and productive capacity. ***Send for Catalog "M"***

BARNES DRILL COMPANY
814 Chestnut St. (Incorporated 1907) **ROCKFORD, ILL.**

AGENTS FOR GREAT BRITAIN: Burton, Griffiths & Co., Ltd., London, E. C. FRANCE: R. S. Stokvis & Fils, Paris. JAPAN: Roku-Roku Shoten, Tokio. ITALY: Alfred Herbert, Ltd., Milan. SPAIN: American Machinery Syndicate, Hudson Terminal Bldg., New York, Barcelona, Madrid, Seville, Bilbao, Santander. NEW SOUTH WALES: R. L. Scrutton & Co., Sydney.

YOUNG, CORLEY & DOLAN, Inc.
Machine Tools

New York and Export Agents

EXCLUSIVE LINES

Owen Milling Machines
No. O. Plain
Nos. 2 and 3 Plain and Univ.

Bickett Planers
36 inch, 42 inch, and 48 inch

Rivett Grinders (N.Y. Dist.)
Automatic Internal Grinders
Hand and Auto. Radial Grinders

Weigel Drilling Machines
21" and 25" Upright Drills.

Rivett Lathes (N. Y. Dist.)
Precision Bench Lathes

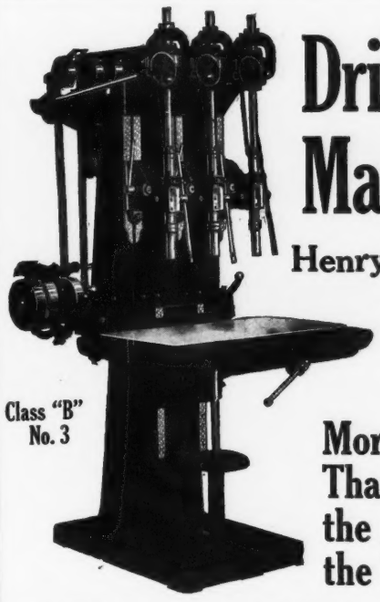
Sterling Grinders
Univ. Tool and Cutter Grinders
Cylindrical 18" x 50", 18" x 60", 18" x 72"

Hilbert Radial Drills
3 ft. Plain

Greaves Engine Lathes

Our N. Y. Warehouse stock list of New Machinery mailed upon request.

115 Broadway New York City



Drilling Machines

Henry & Wright Drilling Machines are doing

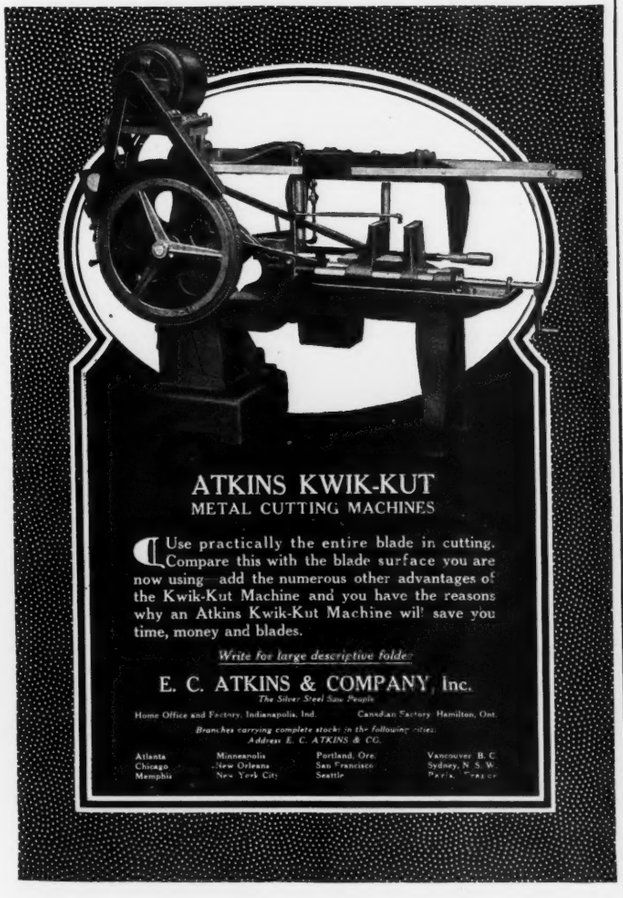
More Drilling Than All the Armies in the World

Drilling millions of holes ¾" and under in every conceivable kind of war munitions. They are preferred because of their many advantages.

THE HENRY & WRIGHT MFG. CO.
HARTFORD, CONN.

OVER-SEAS REPRESENTATIVE
ALMACOA ALLIED MACHINERY COMPANY OF AMERICA ALMACOA
120 BROADWAY, NEW YORK, U.S.A.

PARIS TURIN ZURICH BARCELONA



ATKINS KWIK-KUT
METAL CUTTING MACHINES

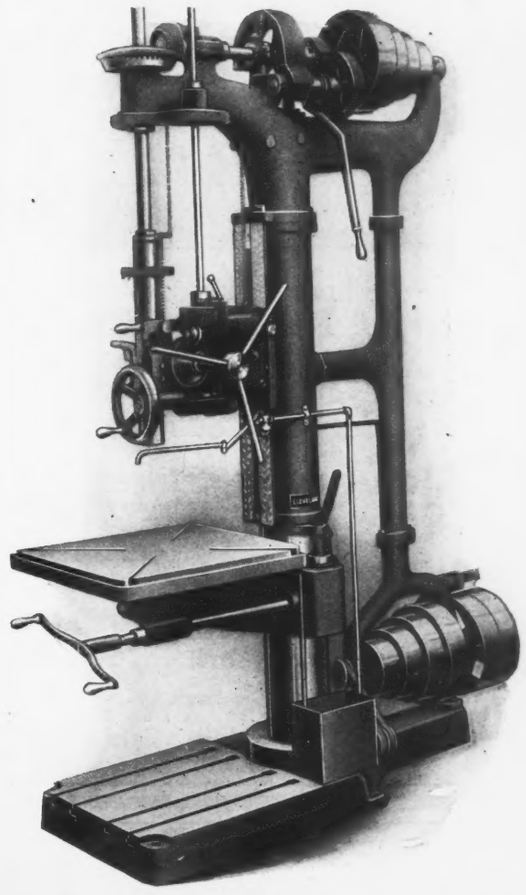
Use practically the entire blade in cutting. Compare this with the blade surface you are now using—add the numerous other advantages of the Kwik-Kut Machine and you have the reasons why an Atkins Kwik-Kut Machine will save you time, money and blades.

Write for large descriptive folder

E. C. ATKINS & COMPANY, Inc.
The Silver Steel Saw People
Home Office and Factory, Indianapolis, Ind. Canadian Factory: Hamilton, Ont.
Branches carrying complete stocks in the following cities:
Address E. C. ATKINS & CO.

Atlanta	Minneapolis	Portland, Ore.	Vancouver, B. C.
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Forethought in Construction



CLEVELAND

32" Upright Drilling Machine

Many tools of yesterday, designed without forethought, are unable to cope with requirements of today. Be sure the drill you buy has, in power, strength and capacity, a margin of safety for the future. The Cleveland has large diameter spindle of special hammered steel, counter balanced, and equipped with patent quick-return mechanism; unusually heavy column, firmly braced; large table, well provided with T slots; easily adjusted automatic stop to down feed, set by graduations on the spindle.

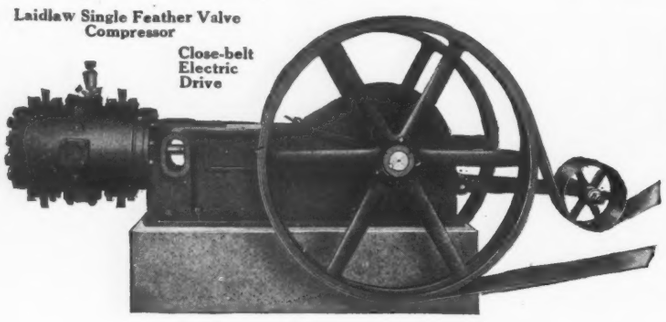
An improved lubricating system insures safe, satisfactory drilling at maximum speeds.

Send for further details.

The Cleveland Machinery & Supply Co.

General Offices: **CLEVELAND, OHIO, U.S.A.**

Factories: **Hamilton, Ohio Columbus, Ohio Richmond, Indiana**



LAIDLAW
Feather Valve
Reg. U. S. Pat. Off.

AIR COMPRESSORS

There's economy and good service in the close-belt type of Laidlaw Feather Valve Compressor. Enclosed frame provides automatic oiling and protection from dirt and flying grit. It requires little attention. Above all, it has the marvelously durable and efficient Feather Valve.

A complete line of Single Power Driven Feather Valve Compressors is shown in Bulletin L531-129. Write for your copy.

Worthington Pump and Machinery Corporation
115 Broadway, New York
Laidlaw Works, Elmwood Place, Cincinnati, O.
Branch Offices in all Principal Cities

L293.4

The Laidlaw Compressor is the Product of a Worthington Plant.

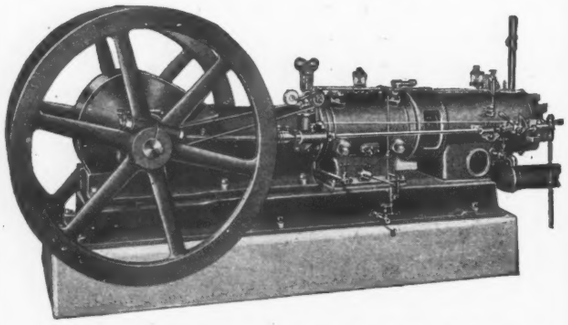
WORTHINGTON

A big line to choose from—a safe line to choose

AIR COMPRESSORS PUMPS CONDENSERS OIL ENGINES

Chicago Pneumatic Simplate Valve

Fuel Oil Air Compressors



Chicago Pneumatic Fuel Oil Driven Simplate Valve Air Compressor will operate on any mineral oil of 28 degrees Beaume scale or lighter, containing not over one per cent sulphur, including Star Oil, Diesol, Calol, Stove Oil, Solar Oil, Gas Oil, Kerosene and distillates between Kerosene and Lubricating Oil. Stationary or portable.

Made in capacities up to 600 cu. ft. of free air per minute.

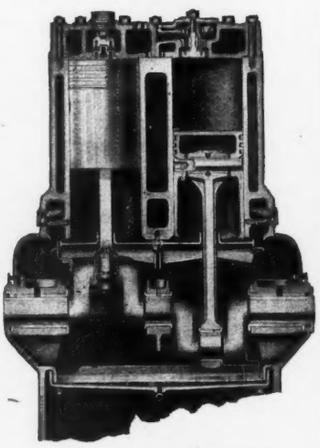
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No stuffing boxes, shoes, slides or guides, less friction and wear, lower maintenance. Will run 10 to 15 times as long with the same amount of oil as competing makes, yet will lubricate all parts properly and keep oil out of the discharge line.



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At Slight Production Cost

This is the function of Ingersoll-Rand Class "ER" and "FR" Compressors.

These small machines are built in quantity on a quality basis. You can obtain any of the various sizes of either type and benefit immediately by the employment of the air power it provides—for a few more air tools will greatly increase the productivity of your men.

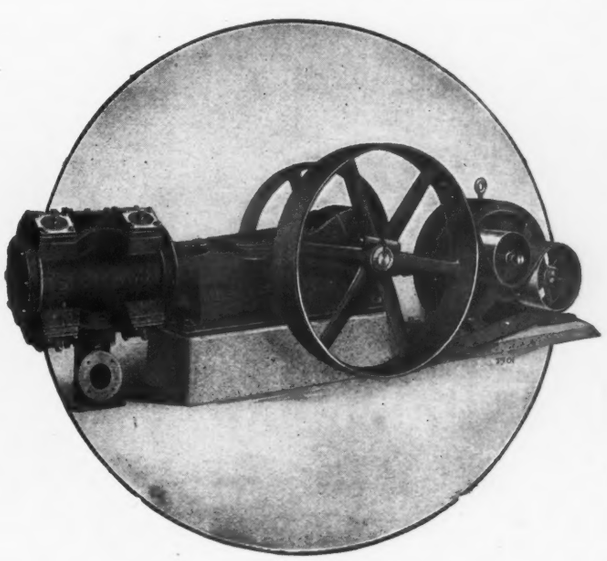
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Capacities range from 50 to 1000 cu. ft. at pressures from 10 to 250 lb. per sq. in.

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Ingersoll-Rand Class ER Compressor

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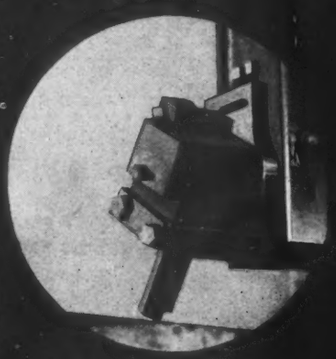
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298-C

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Inconspicuous But Most Important

Casting and machine in the accompanying photograph are both of more than usual size. The tool, however, though inconspicuous in the performance, is the most vital factor in the production. Given a machine sufficiently powerful, the right tool will "come through" in practically any service.

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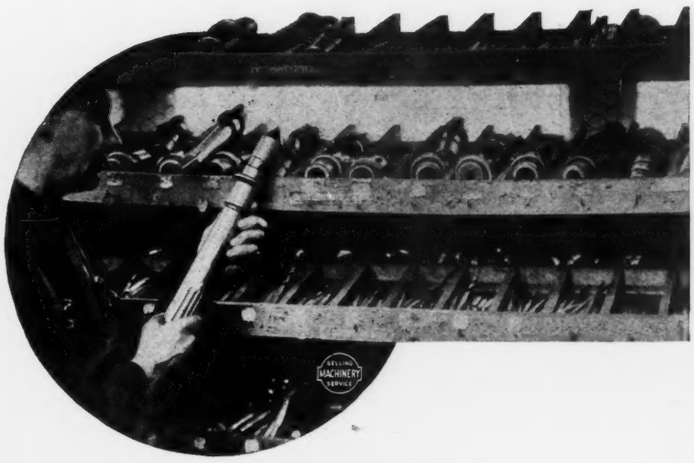
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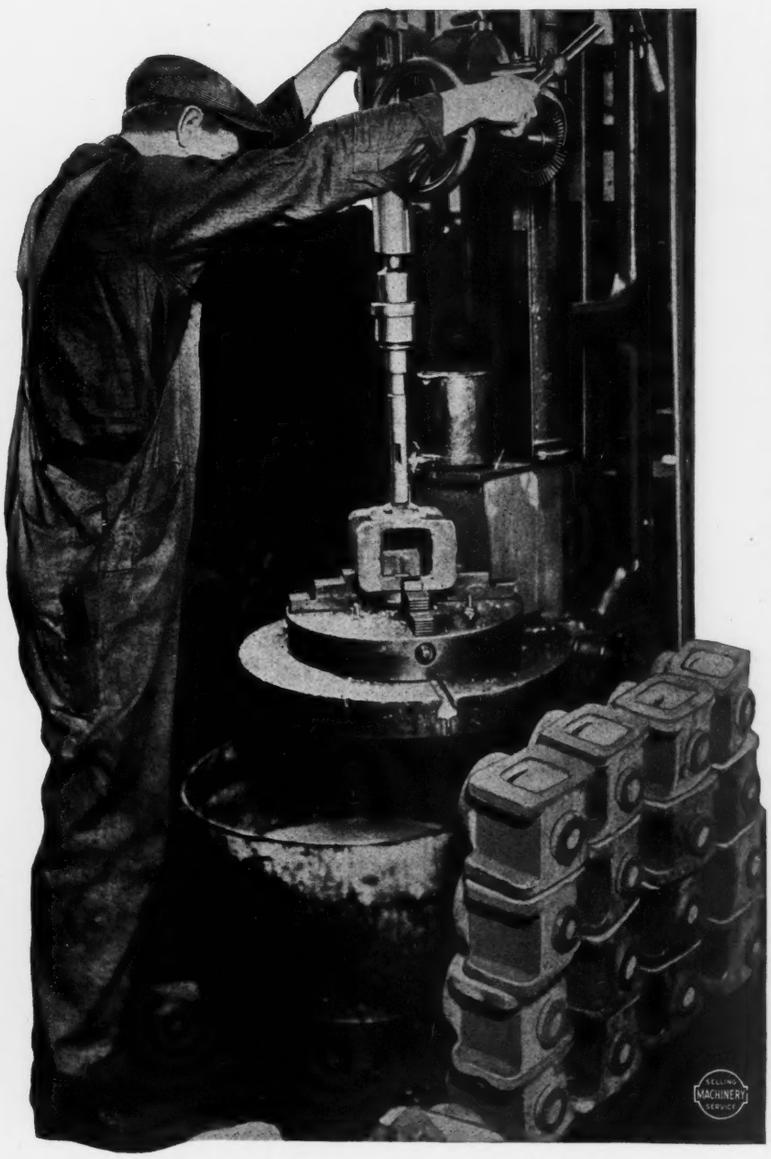
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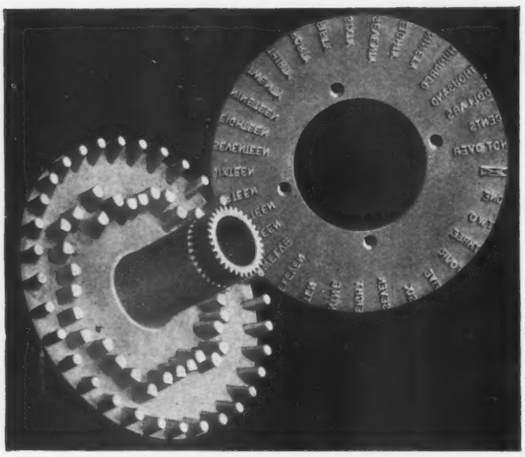
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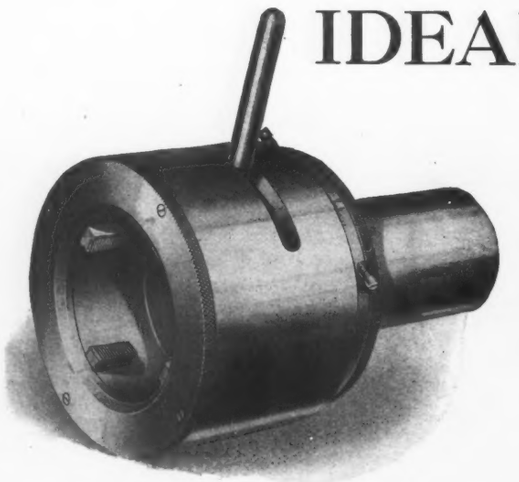
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HAVE SMALL O. D.

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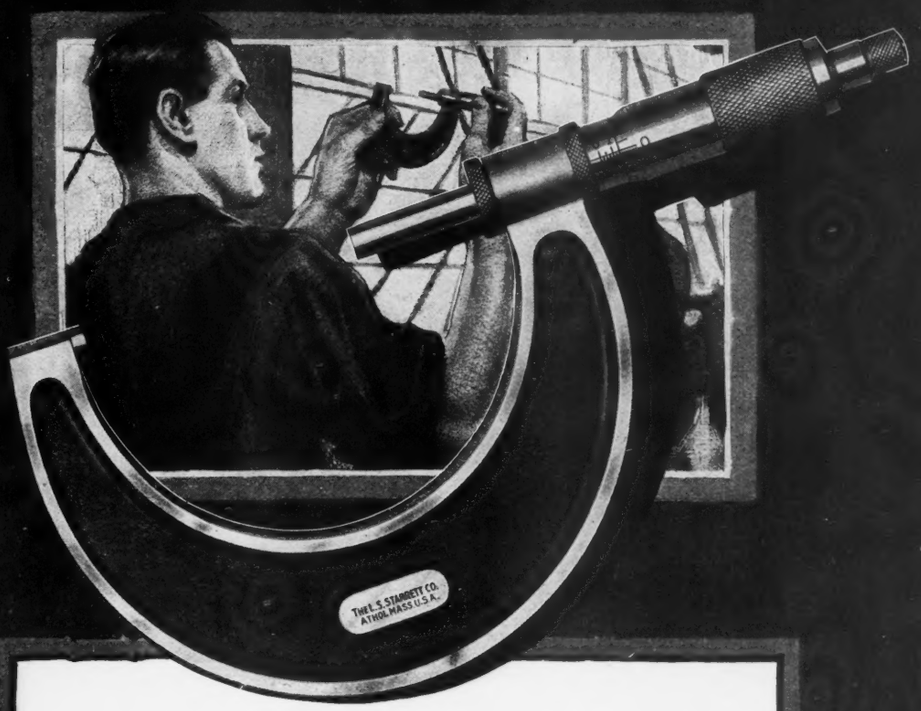
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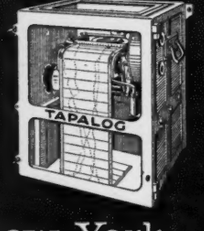
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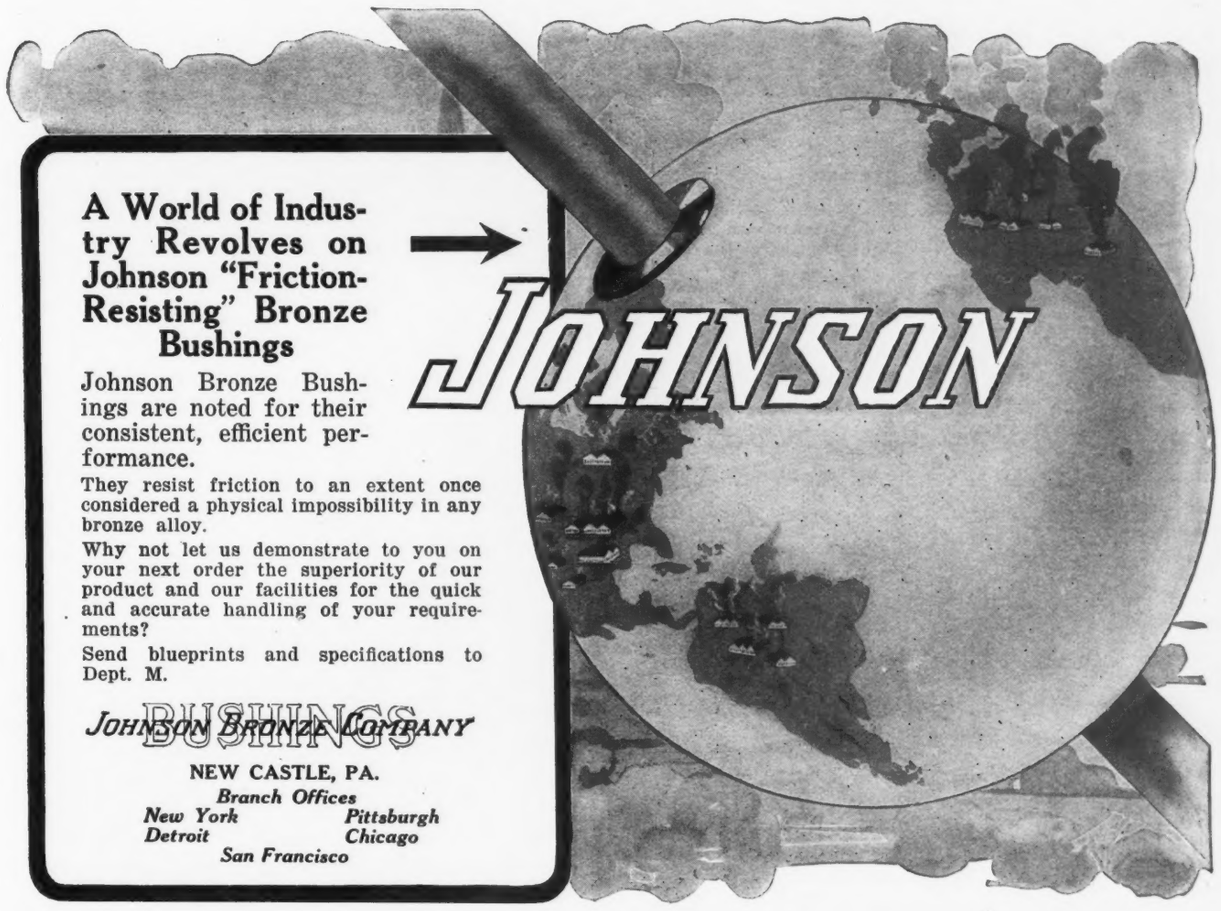
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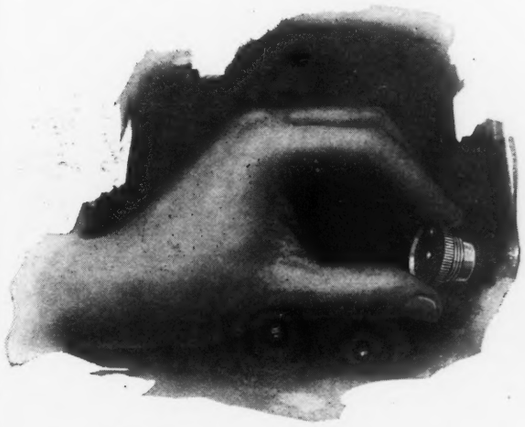
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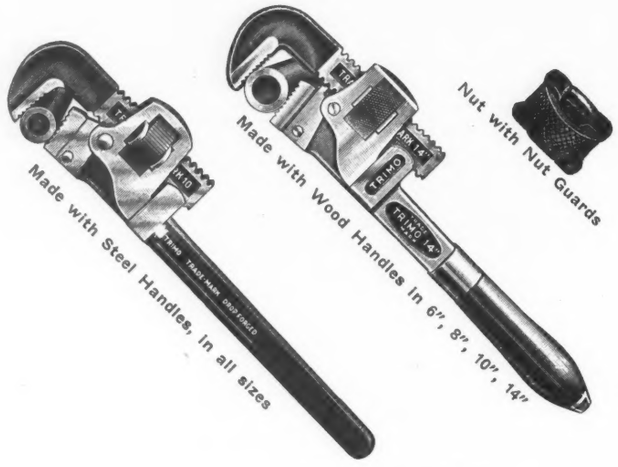
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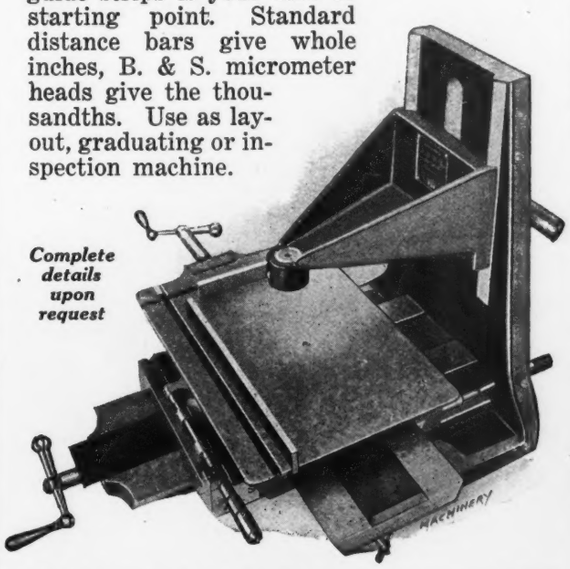
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For locating and machining holes in dies, jigs, master-plates, etc. Adjust bushing to work and use as a master-plate; no layout required, no cumulated error; inner edge of guide strips is your zero or starting point. Standard distance bars give whole inches, B. & S. micrometer heads give the thousandths. Use as layout, graduating or inspection machine.

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For increased output does not require enlarging your own facilities. You can use ours—and save by doing it.

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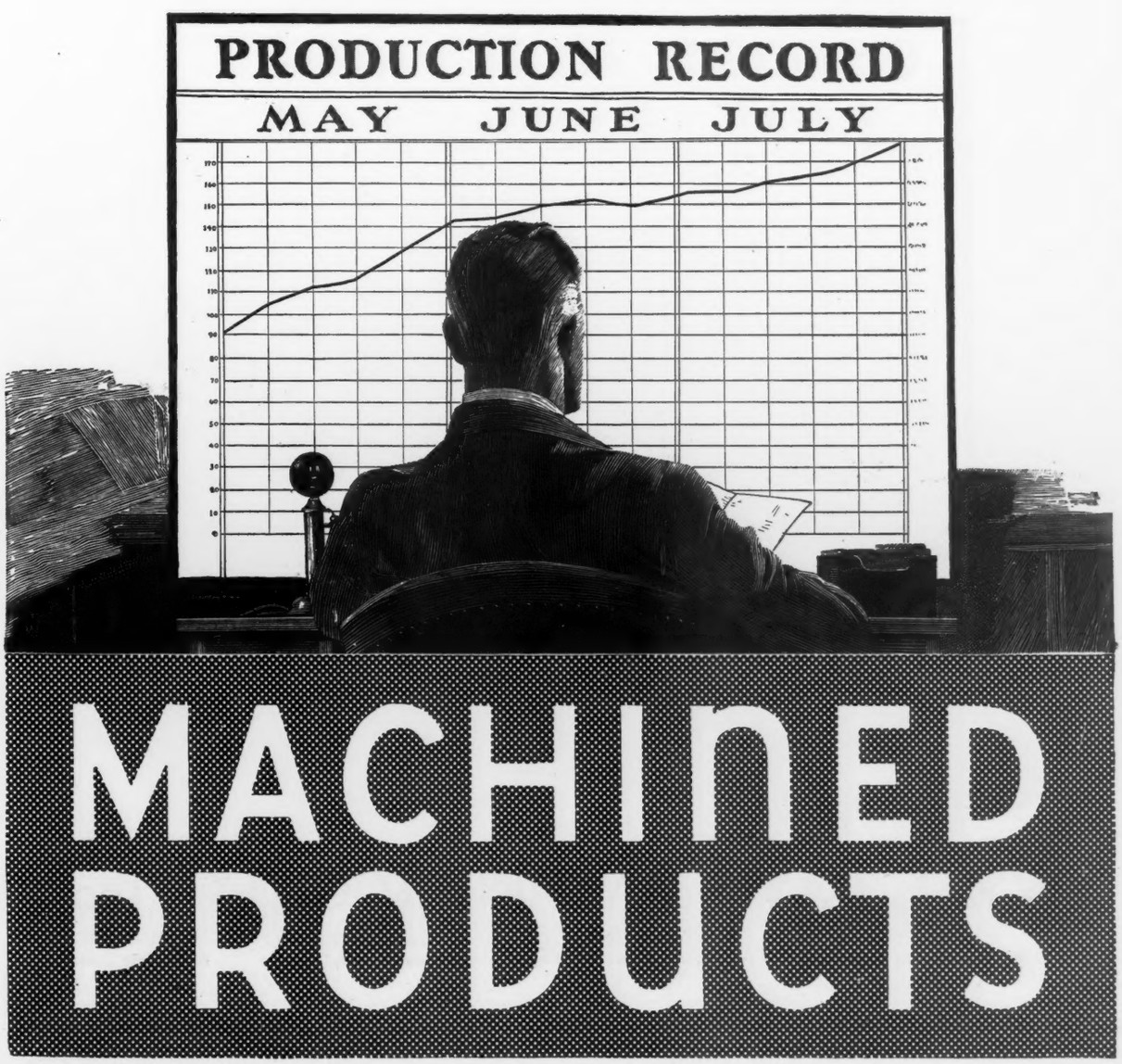
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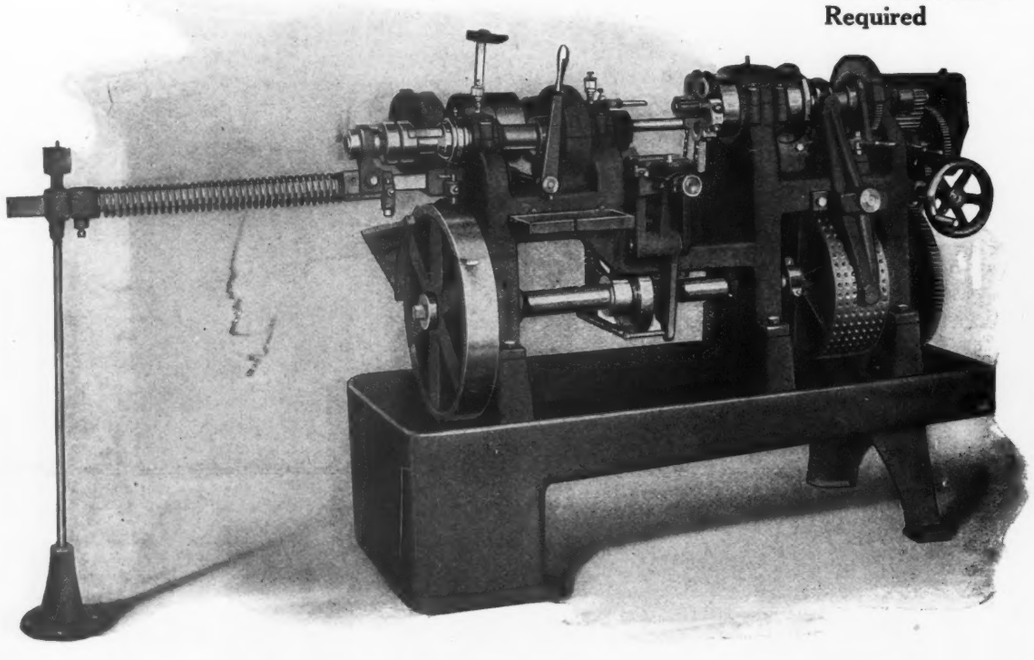
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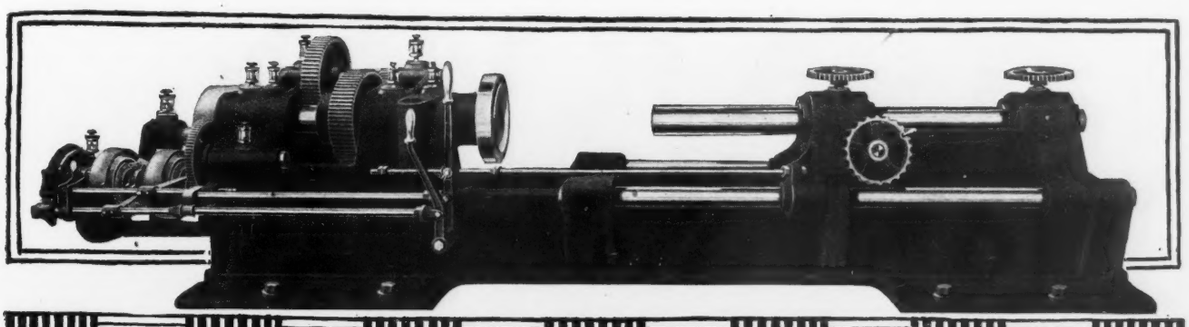
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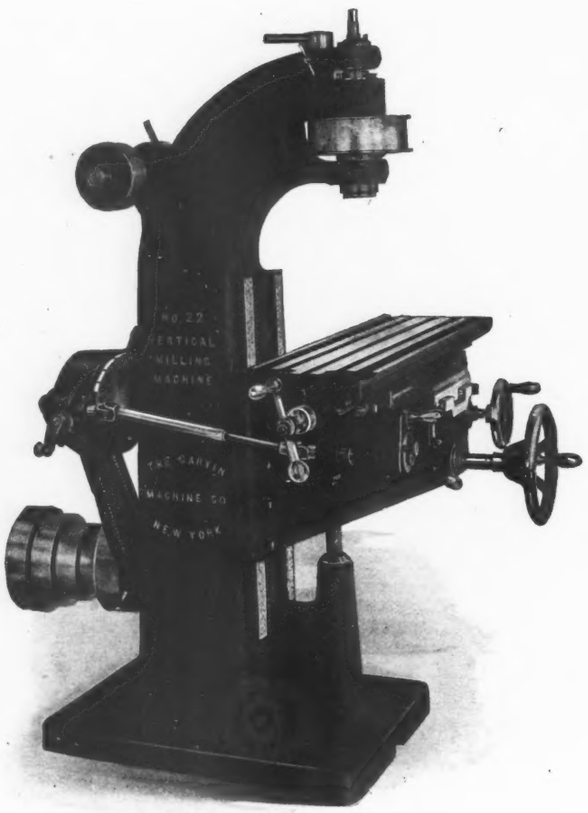
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The machine is equipped with our

SOLID TOP EXTENDED (Patented) KNEE SQUARE LOCKED

doing away with all possibility of weakness of saddle fit to knee.

Positive Feed Change Box giving twelve instantaneous changes of feed.

The feed can be changed while the machine is in cut.

The design is suitable for high speeds, the spindle being driven direct or through double back-gearing to slow down for large cutters.

A Rotary Table is a most important adjunct to the machine and forms the most efficient feed for circular milling, finishing circular slots and edges, etc.

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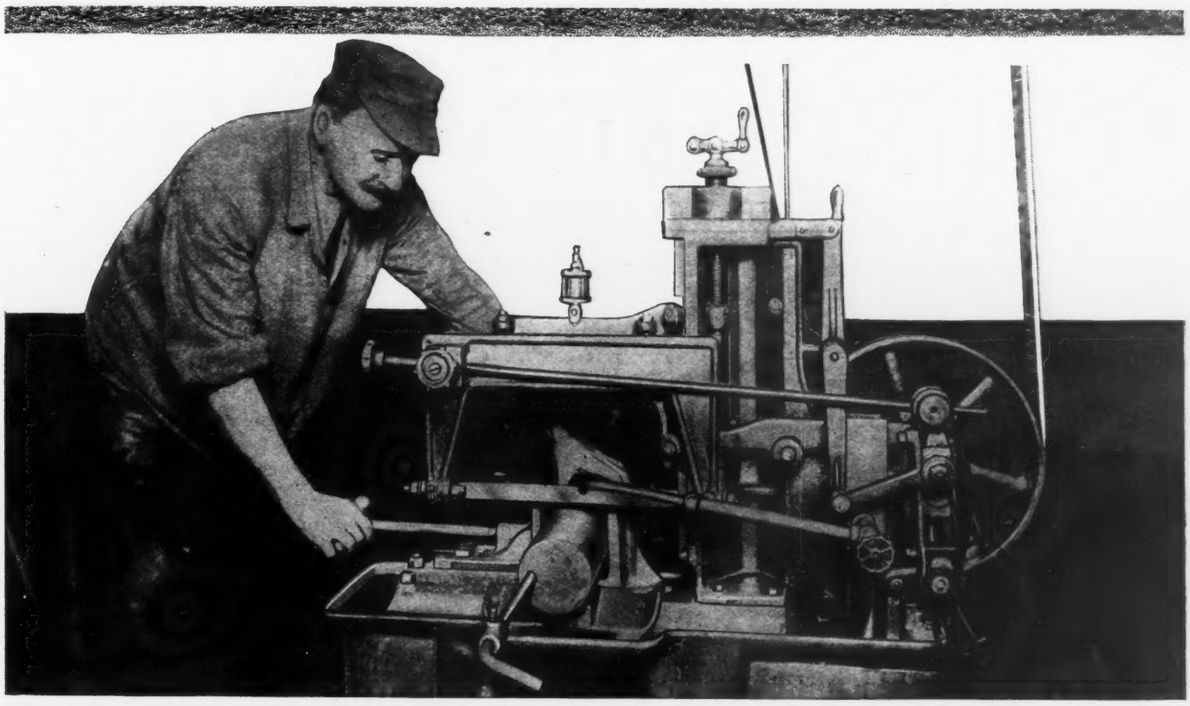
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THREE conditions govern every Hack Sawing job; the machine, the material, and the blade. When the first two are neglected it does not make much difference what kind of a blade you use. But when machine and material conditions are understood and the proper size blade is selected ***then you will notice,*** beyond a doubt, ***the extra wear*** and ***the quicker cut*** obtained ***with a Simonds blade.***

We will be glad to discuss with you the question of proper blades for different kinds of work.

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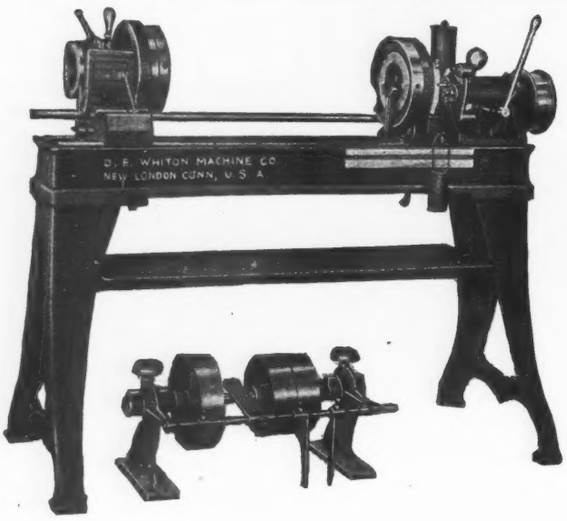
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FOR ACCURATELY CENTERING FINISHED SHAFTS



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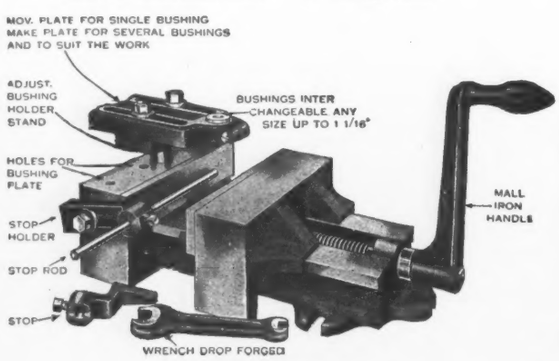


Fig. 1. With Jig Attachments.

Always a good vise for general shop use on driller, miller, shaper, or planer, and at the same time holds work for duplicate drilling without the cost of a jig.

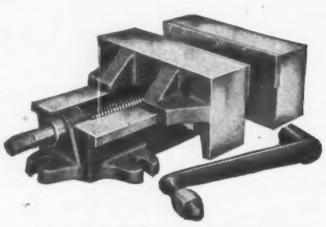


Fig. 2. Without Jig Attachments.

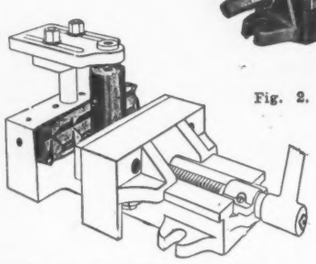


Fig. 3.—V-Jaw for Round Work.

VISE

No. 3, jaws 6", opens 4½", with attachments, $22.00; without, $20.00. List.

No. 4, jaws 9", opens 7"; with attachments, $27.50; without, $25.00. List.

No. 5, jaws 12", opens 9½", with attachments, $40.00; without, $36.00. List.

DRILL SPEEDER

No. 2, with chuck, drills 0" to 5/16". List, $25.00.

No. 3, with chuck, drills 0" to ½". List, $27.50.

No. 3B, with No. 1 Morse hole instead of chuck, $27.50.

No. 4, with chuck, drills 0" to ¾". List, $40.00.

No. 4B, with No. 2 Morse hole instead of chuck, $33.00.

No. 2L, with chuck, drills 0" to ⅝". Has feed lever mechanism. List, $33.00.

All Patented. Send for Circular.

The Graham Mfg. Co.

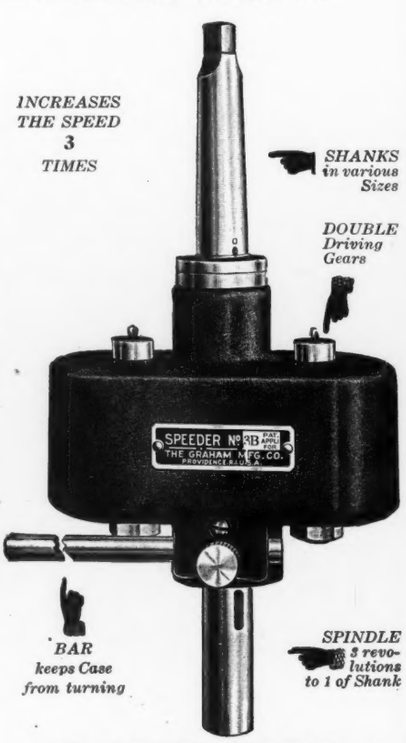
Providence, Rhode Island

Great Britain: Burton, Griffiths & Co., Ltd. France, Italy, Switzerland, Spain and Holland: Fenwick Freres & Co.

DRILL SPEEDER

For use in Drillers from 20-inch to largest Radial
For Twist Drills 0" to ¾" requiring speed up to 3000 R. P. M.

INCREASES THE SPEED 3 TIMES



SHANKS in various Sizes

DOUBLE Driving Gears

BAR keeps Case from turning

SPINDLE 3 revolutions to 1 of Shank

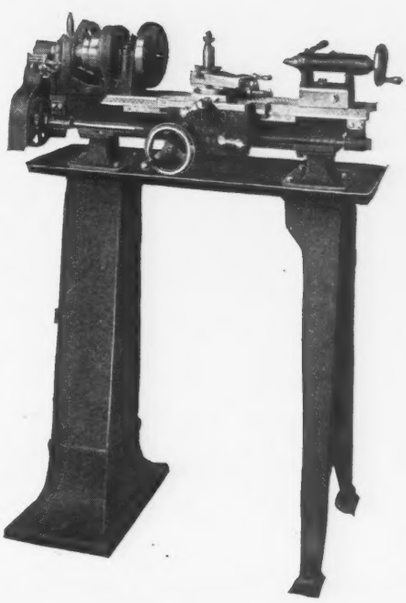
This cut shows Nos. 3B and 4B only. There are two other styles and sizes.



OVER THE TOP
with the
"DALTON SIX"



YOU can go "OVER THE TOP" in your production with a "DALTON SIX". Don't ask us why. Ask the manufacturer who uses them; not one machine only, but in many cases ten to one hundred in the same plant.



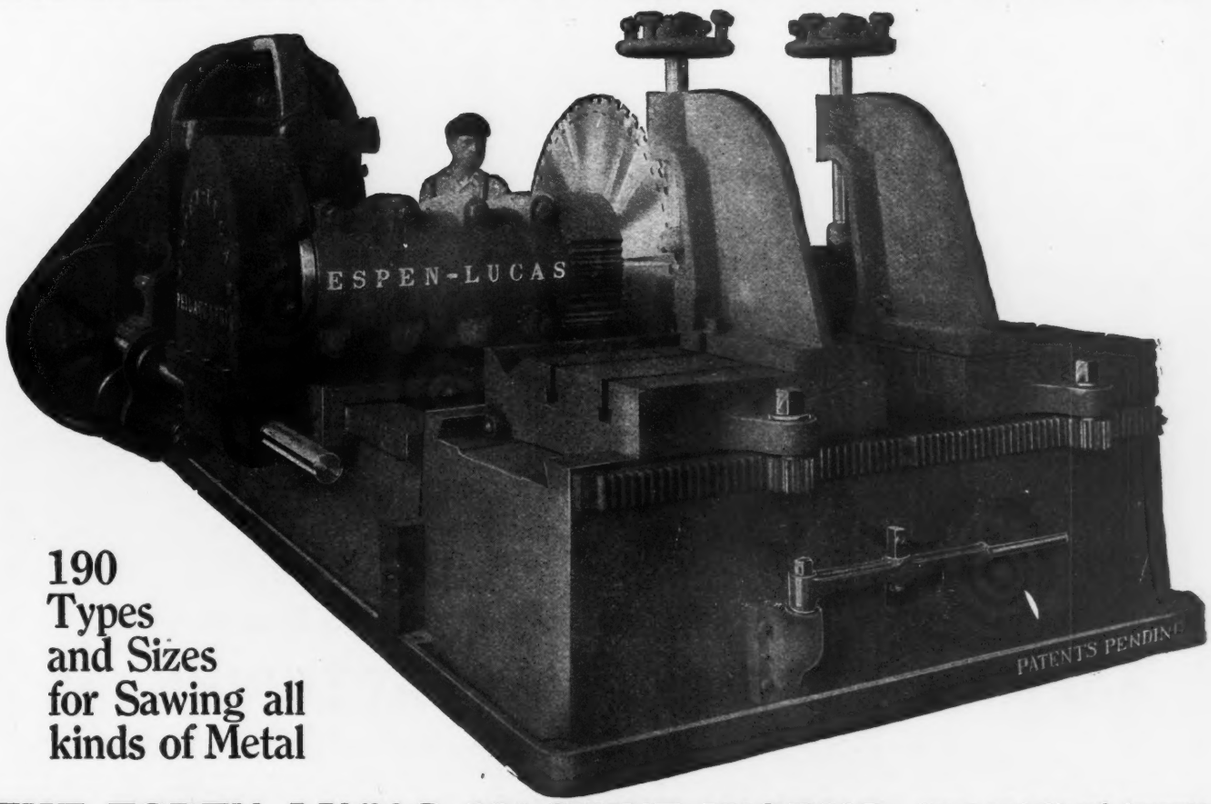
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DALTON MANUFACTURING CORPORATION

1915 PARK AVENUE, NEW YORK, U. S. A.

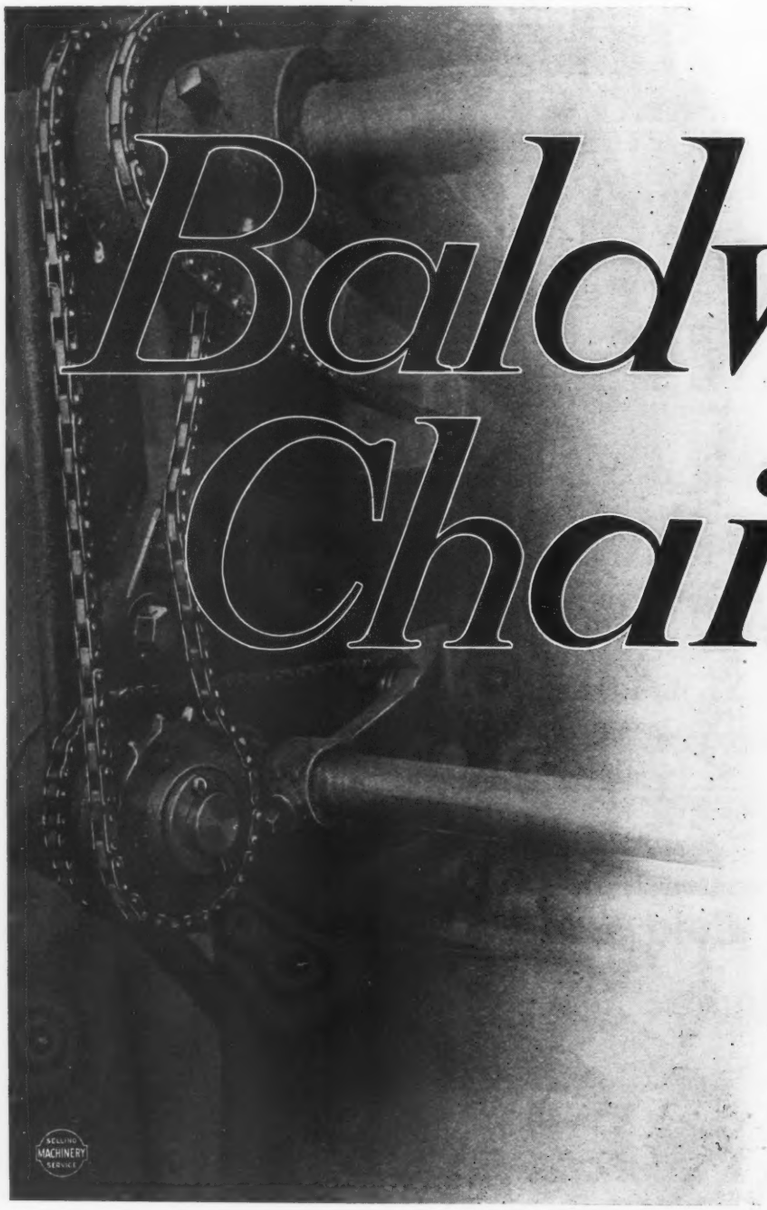
Cable Address "ALEDAL New York"

One of the Fastest Cold Sawing Machines in the World



190
Types
and Sizes
for Sawing all
kinds of Metal

THE ESPEN-LUCAS MACHINE WORKS, Front and Girard Avenues PHILADELPHIA, PA.



Baldwin Chain

For Power Transmission Purposes where Conditions are Severe

Watch a Kidder Printing Press in operation. Note the smoothness and regularity of its action, for which the makers give Baldwin Chain a fair share of the credit.

In equipping the Kidder Press they were confronted with a difficult driving problem. The intermittent load made a belt drive impossible, because it might slip, and center distances of 24 and 28 inches put gears out of the question.

After exhaustive experiments they put a couple of Baldwin Chains on the job, provided the vertical drive with an adjustable idler, to maintain the proper tension on the chain, and their troubles were over.

Every Kidder Press put on the market in the past 12 years has been equipped with Baldwin Chains. Their action is positive and reliable and they do not stretch.

No load too heavy for a Baldwin Chain. Try one—write Department S.

BALDWIN CHAIN & MANUFACTURING CO.

WORCESTER, MASS., U. S. A.

AGENTS: C. D. Schmidt, 276 Canal St., New York City. W. D. Foreman, 1607-1611 Prairie Ave., Chicago, Ill. N. A. Petry Co., Inc., 1307 Race St., Philadelphia, Pa. Walter H. Williams, 175 Massachusetts Ave., Boston, Mass. M. A. Bryte, 788 Mission St., San Francisco, Cal. Motor & Machinists Supply Co., Kansas City, Mo. M. & M. Co., Cleveland, Ohio. Neustadt Automobile & Supply Co., St. Louis, Mo. C. J. Smith Co., St. Paul, Minn. J. M. Howe, 245 Plymouth Bldg., Minneapolis, Minn. The Wirthlin-Mann Co., 318-320 West Third St., Cincinnati, O.

LINK-BELT
SILENT CHAIN DRIVES

Hasten War Munitions Production



TODAY, conservation is the watchword throughout the nation, not only in food and fuel consumption, but human energy and power as well. "Who Saves Serves."

Link-Belt Silent Chain Drives not only save power, but they speed up production and enable each man to accomplish more work each day as well. They are helping to hasten the production of war munitions everywhere.

Long after belts have slipped a million times—long after gears fail to mesh properly and are making a noise like a "rattle trap"—years longer, Link-Belt Silent Chain Drives will be operating as smoothly and efficiently as ever.

For Link-Belt Silent Chain Drives are "flexible as a belt, positive as a gear, and more efficient than either." Proof is given in our Machine Tool Drive Book No. 312. Send for a copy.

LINK-BELT COMPANY

PHILADELPHIA CHICAGO INDIANAPOLIS

New York	299 Broadway	Detroit	732 Dime Bank Bldg.
Boston	49 Federal St.	Minneapolis	418 S. Third St.
Pittsburgh	1501 Park Bldg.	Kansas City Mo.	407 Finance Bldg.
St. Louis Cent. Nat'l Bank Bldg.		Seattle	576 First Ave. S.
Buffalo	696 Ellicott Square	Portland, Ore	First and Stark Sts
Wilkes-Barre,	2d Nat'l Bk. Bldg.	San Francisco	461 Market St.
Cleveland,	429 Rockefeller Bldg.	Los Angeles	161 N. Los Angeles St.
Denver		Lindrooth, Shubart & Co.,	Boston Bldg.
Louisville, Ky.		Frederick Wehle,	Starks Bldg.
Knoxville, Tenn.		D. T. Blakey,	Empire Bldg.
New Orleans		C. O. Hinz,	Hibernia Bank Bldg.
Charlotte, N. C.,		J. S. Cothran,	Com'l Bank Bldg.
Toronto, Can.		Canadian Link-Belt Company,	Ltd.

138

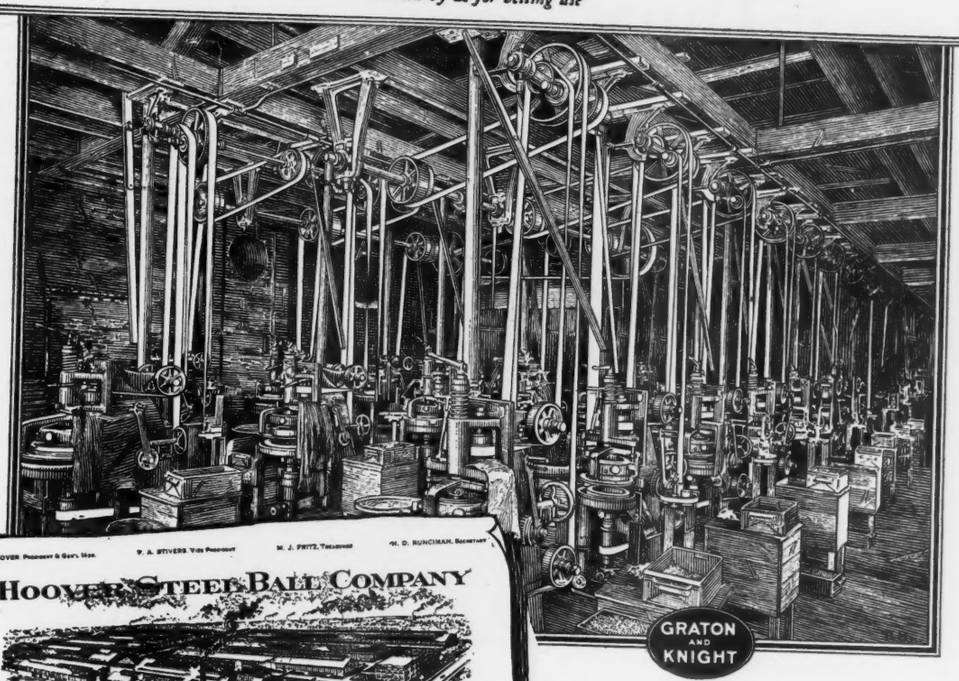

"Pioneer"
STEEL HANGERS
Have Taken
The Hard
Work Out
of Shaft
Hanging
There was a time when hanging shafting was a back-breaking job.
Now it is different—because "Pioneer" Steel Hangers weigh about one-third as much as the old-style cast iron.
The cost of the millwrighting is also very materially reduced and the "Pioneer" does not break—Never.
Its price is no higher.
Ask for a copy of our new booklet "Transmission Data". Contains some plain truths worth reading.
STANDARD PRESSED STEEL CO.
PHILADELPHIA, U. S. A.
SELLING MACHINERY SERVICE

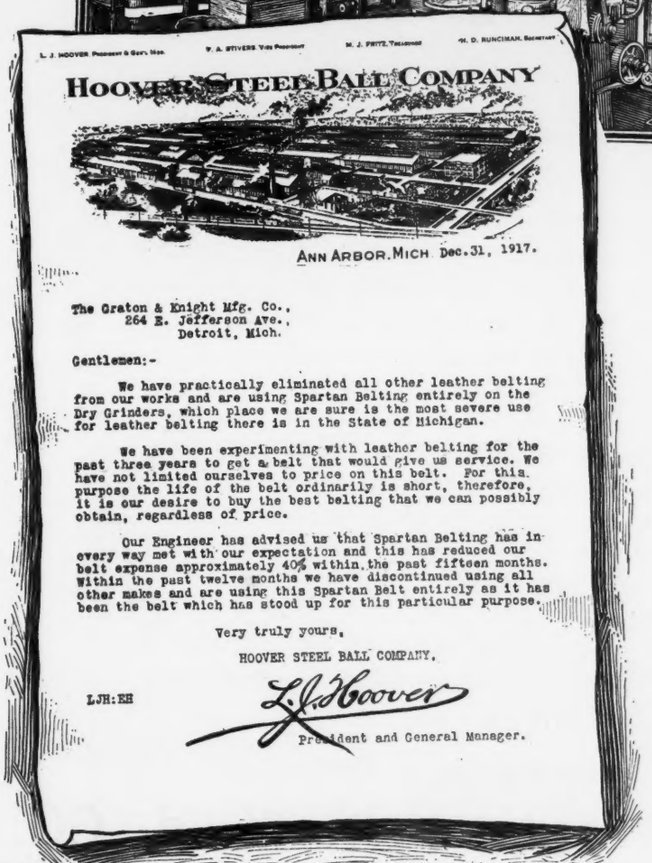
GRATON & KNIGHT

Standardized Series

LEATHER BELTING

Tanned by us for belting use





HOOVER STEEL BALL COMPANY

ANN ARBOR, MICH Dec. 31, 1917.

The Graton & Knight Mfg. Co.,
264 E. Jefferson Ave.,
Detroit, Mich.

Gentlemen:-

We have practically eliminated all other leather belting from our works and are using Spartan Belting entirely on the Dry Grinders, which place we are sure is the most severe use for leather belting there is in the State of Michigan.

We have been experimenting with leather belting for the past three years to get a belt that would give us service. We have not limited ourselves to price on this belt. For this purpose the life of the belt ordinarily is short, therefore, it is our desire to buy the best belting that we can possibly obtain, regardless of price.

Our Engineer has advised us that Spartan Belting has in every way met with our expectation and this has reduced our belt expense approximately 40% within the past fifteen months. Within the past twelve months we have discontinued using all other makes and are using this Spartan Belt entirely as it has been the belt which has stood up for this particular purpose.

Very truly yours,

HOOVER STEEL BALL COMPANY.

LJH:EH

L. J. Hoover

President and General Manager.

"the most severe use of leather belting" (see letter)

The advantages of standardized belting stand out *most conspicuously* in severe use, but they are *just as truly present* in less exacting conditions. Dollars are valuable whether you save them by tens or by hundreds.

The steps in acquiring transmission-wisdom run somewhat as follows: A poor belt is better than none at all. A good belt is better value than a poor one. But the scientifically right belt for each machine is the highest economy of all—and that is Standardization. It also explains why there is greater demand for Graton & Knight Standardized Series Leather Belting than for any other brand in the world.

Write for information about Standardization as applied to Belting.

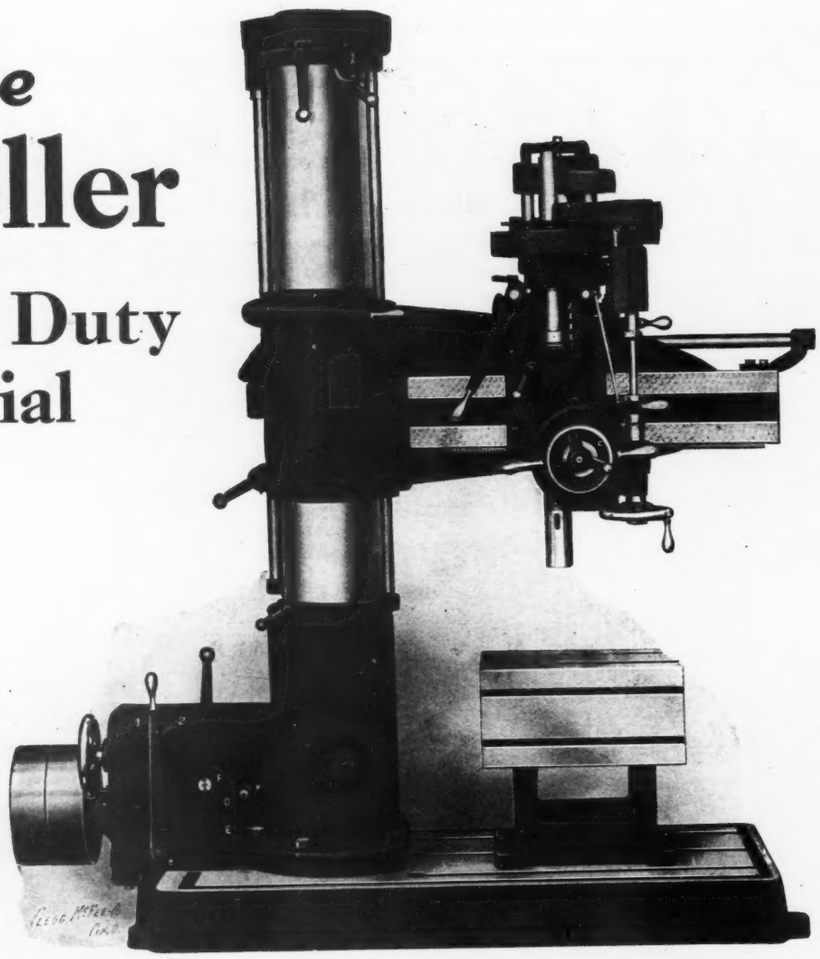
The Graton & Knight Mfg. Co.
Worcester, Mass., U. S. A.

Oak Leather Tanners, Makers of Leather Belting, Lace Leather, Packings, and Specialties.

Branches and Distributors in all Principal Cities.

The Mueller

Heavy Duty Radial



Just as American men responded to the call to arms, American machines rose to their allotted task. The Mueller Radial has been among the leaders from the start—a pace setter for the hard, continuous production necessary to supply the needs of the fighting forces.

Well designed, well constructed, readily controlled and fool proof, this heavy duty machine drives high speed drills to capacity and has a reputation for seldom being down for repairs.

Special features include patented, one piece, re-inforced column, long bearing of arm on column, combination positive and friction feed, friction reverse, etc. Let us tell you all about it.

THE MUELLER MACHINE TOOL CO.

CINCINNATI *Radial Drills and Lathes* **OHIO, U. S. A.**

A Word to the Wise About WEIGEL

Weigel 25-inch Vertical Drilling Machine, a machine that "Made Good" quickly. Here's the reason—

We say that the new Weigel 25″ Vertical Drilling Machine has "taken hold" of the market. Buyers have accepted this improved machine. It has "made good" in a surprisingly short time.

Gold bricks as a commodity have entirely succumbed. Particularly in the machine tool industry, one has to have "the goods" in order to "get across."

The sole purpose of this advertisement is to convince you that you can easily convince yourself that the makers of the new Weigel have "the goods." And our advice is:

(1) **See it work, or**

(2) **Ask somebody who has seen it work, or**

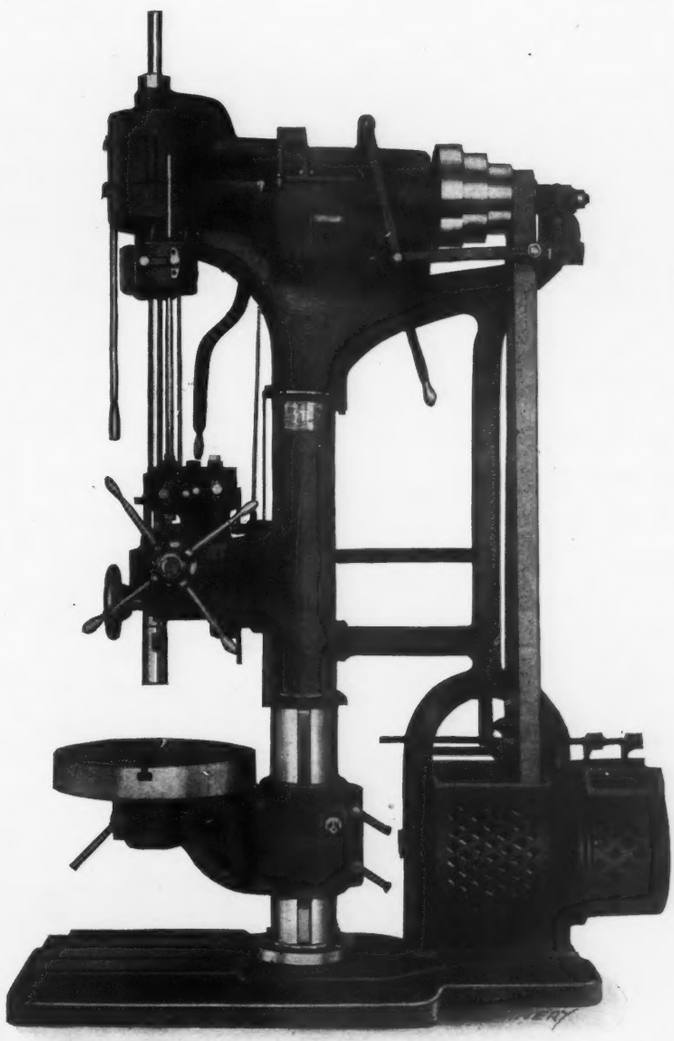
(3) **At least send for the specifications.**

Most important of all, though—do it now.

That's the Weigel →

Weigel Machine Tool Company
PERU INDIANA

The makers of this new machine have designed and built high grade machine tools for more than thirty years—the reason beyond a doubt for the instant popularity of the newest of their creations. The new Weigel drills to the center of a 25⅝″ circle, and is furnished with our improved friction type back gears, with special babbitted bearings, or with Damascus bronze bearings throughout.



Quick, Complete Demagnetization



Removes the Only Objection to the Use of the Magnetic Chuck

The Smith Demagnetizer demagnetizes parts quickly, completely and at but a fraction of the present cost, thus removing the sole objection to the use of magnetic chucks. The rate of production is limited only by the speed with which the operator can feed the parts to the machine.

Made in a variety of sizes.
Send for complete details.

Wm. F. Davis Machine Tool Co., Inc.

CHICAGO
549 W. Washington Blvd.

CLEVELAND
508 Leader News Bldg.

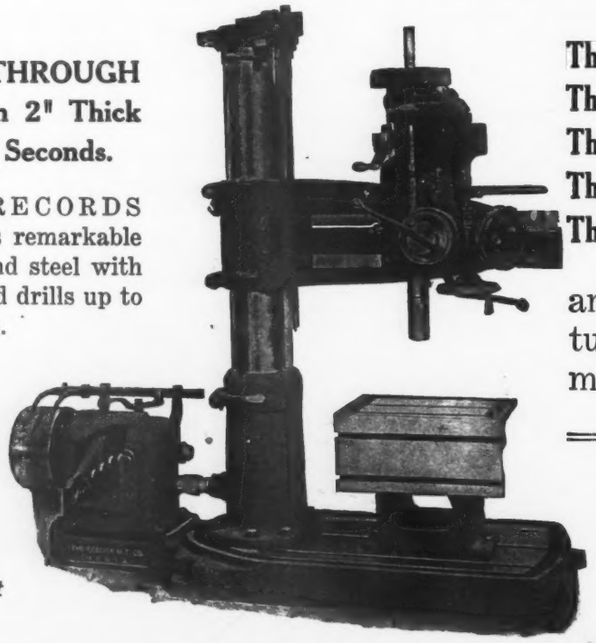
NEW YORK
85 Liberty Street

WASHINGTON
945 Pennsylvania Avenue

FOSDICK 2 and 2½ FT. HEAVY DUTY RADIALS

1" Drill THROUGH Cast Iron 2" Thick in 7 4/5 Seconds.

OTHER RECORDS equally as remarkable in iron and steel with high speed drills up to 2½ inches.



The INTERCHANGEABLE DRIVE
The EXTRAORDINARY POWER
The LUBRICATING SYSTEM
The HARDENED BEVEL GEARING
The BRONZE BUSHINGS

and many other valuable features will be found in these machines.

Send for drilling and tapping test sheet

THE FOSDICK MACHINE TOOL COMPANY

CINCINNATI OHIO, U. S. A.

AGENTS: Biggs-Watterson Co., Cleveland, Ohio. Colcord-Wright Mchy. & Supply Co., St. Louis, Mo. Eccles & Smith Co., San Francisco, Cal., Los Angeles, Cal., Portland, Oregon. Fairbanks Co., New York City, N. Y., Hartford, Conn., Albany, N. Y. E. A. Kinsey Co., Cincinnati, Ohio, Indianapolis, Ind. J. L. Osgood, Buffalo, N. Y. Peninsular Machinery Co., Detroit, Mich. H. A. Smith Machinery Co., Syracuse, N. Y. Swind Machinery Co., Philadelphia, Pa. Somers, Fitler & Todd Co., Pittsburgh, Pa. Stocker-Rumley-Wachs Co., Chicago, Ill., Milwaukee, Wis. Taylor Machinery Co., Boston, Mass. A. R. Williams Machinery Co., Ltd., Toronto, Ont., Canada. Burton, Griffiths & Co., Ltd., London, England. Fenwick Freres & Co., Paris, France. Wynmalen & Hausmann, Rotterdam, Holland. Rylander & Asplund, Stockholm, Sweden. Wilh. Sonesson & Co., Malmo, Sweden, Copenhagen, Denmark. Roku-Roku Shoten, Tokyo, Japan. R. L. Scrutton & Co., Sydney, Australia.

Efficiency in the *highest degree* is what the U. S. Government desires, and that is why it is such a large purchaser of

Gray's Sheet Metal Cutter No. 1

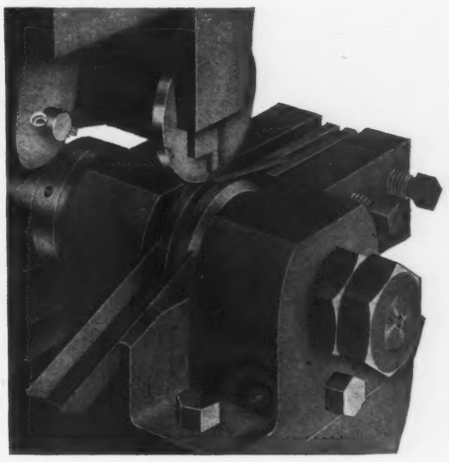
(PATENTED)

Not a Rotary Shear

This machine cuts Sheet Metal up to 3/16" in thickness, into any conceivable shape, and leaves every portion in its former flat condition.

Ordinarily a saving of 10 per cent justifies installing a more modern machine. On work within the scope of this machine, present users are saving from 75 to 90 per cent in labor alone. It does mechanically what you have heretofore been doing by hand and usually with skilled labor. Don't overlook the saving in material, due to method of cutting. It is a big item in itself.

Saving of man power today is of the greatest importance, and if you are not yet familiar with the possibilities of this machine, become so at once.



End View Showing Cutting Mechanism

Write for Illustrated Circular

W. J. SAVAGE COMPANY, Inc.

KNOXVILLE TENN.

Rowbottom for Cams

It is one thing to design a cam that will "perform a required amount of work in a given time;" but quite another to cut and finish it economically—unless you have a

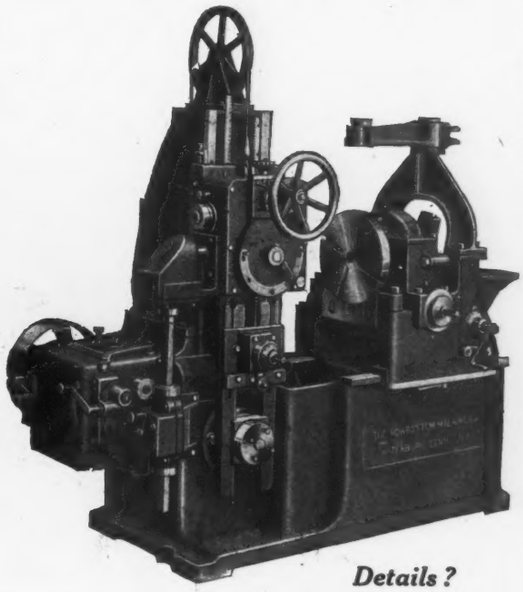
ROWBOTTOM CAM MILLING MACHINE

Specially designed to cut and finish cams—barrel, face, frog, yoke, box, etc.—this machine is a rapid, accurate producer and imparts a fine, smooth finish to the work.

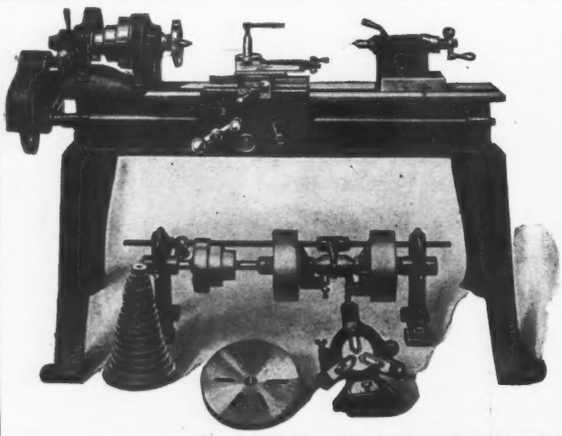
If you cut many cams, you'll find this machine a profitable investment; if few, it will pay you to let us cut them for you the "Rowbottom" way.

The Rowbottom Machine Co.

Factory WATERVILLE, CONN. WATERBURY, CONN., U.S.A.



Details?



The VICTOR LATHE

is an ideal machine for precision manufacturing, tool room and experimental work. Regularly cuts threads from 4 to 40—special and metric threads with extra gears. It swings 10″ over ways, is 9″ between centers, has power cross feed, longitudinal power feed, reverse lever on headstock and fully covered gears. Furnished with bench or floor legs, countershaft or foot power.

Better description in circular

VICTOR LATHE COMPANY
151 Lafayette Street NEW YORK CITY

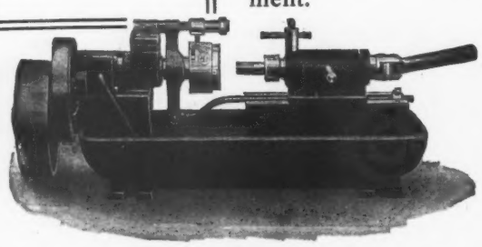
H&G

Threading Machines

are well liked by munition makers and airplane manufacturers. They are designed for high grade precision work such as threading nickel steel airplane parts and similar exacting work.

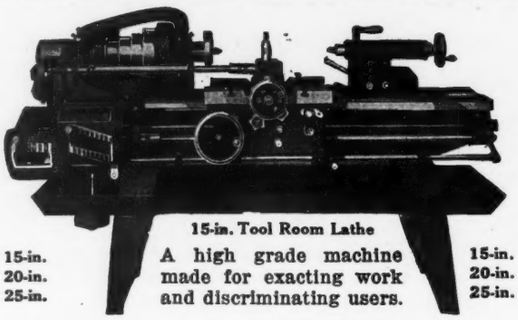
Equipped with the H&G Automatic Self-Opening Die Head they cut threads to a given point or right up to the shoulder and maintain true alignment.

New catalog gives all the details



Eastern Machine Screw Corp.
New Haven, Conn., U. S. A.

CRAWFORD LATHES



15-in. Tool Room Lathe

15-in.
20-in.
25-in.

A high grade machine made for exacting work and discriminating users.

15-in.
20-in.
25-in.

CRAWFORD MACHINE TOOL CO., Inc.
21 Park Row NEW YORK



10-inch Screw Cutting Engine Lathe

The
"SUMMIT"

Is the outgrowth of twenty-five years' experience in machine-tool building—a practical lathe, efficient, durable and a more than creditable producer.

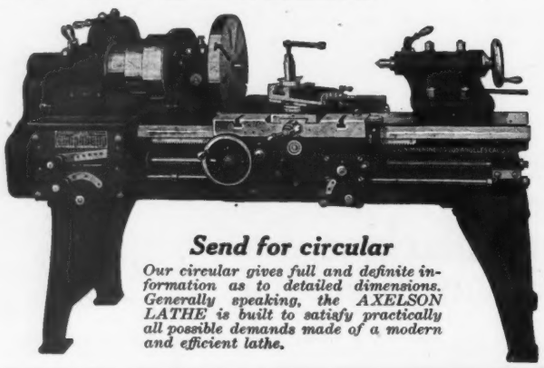
Write for details

SUMMIT MACHINE WORKS, 54 Hermon St., Worcester, Mass.

AXELSON LATHES

RENDER SATISFACTION

Viewed from every angle: Materials, Workmanship, Practicability and from every other viewpoint, AXELSON LATHES are *extraordinary* machines.



Send for circular

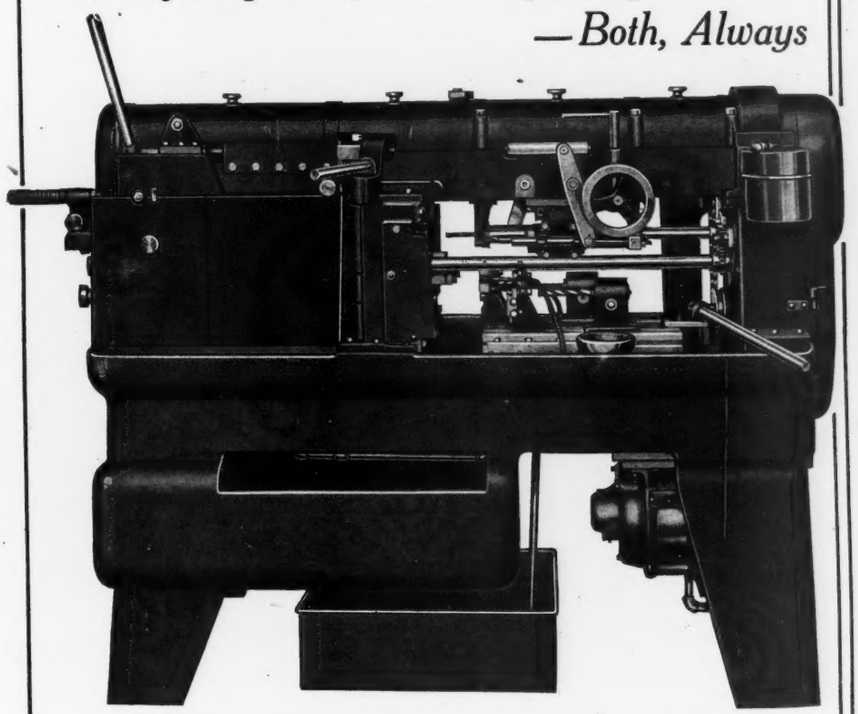
Our circular gives full and definite information as to detailed dimensions. Generally speaking, the AXELSON LATHE is built to satisfy practically all possible demands made of a modern and efficient lathe.

ACCURACY and RIGIDITY are two prominent attributes which distinguish the AXELSON LATHES and make them *different* from every other existing lathe.

Axelson Machine Company
Department E. Los Angeles
California, U. S. A.

THE CONE Accurate AUTOMATIC

Not "Quality First," Not "Quantity First"—
—Both, Always



The Cone *Accurate* Automatic is an exceptionally well designed and well constructed machine. For producing high quality work at consistent costs, it has no equal.

Adjustable bearings, which compensate for wear and insure permanent accuracy, are an exclusive feature. There are many others which help to make a prompt investigation worth while.

Let us send you more detailed information

CONE AUTOMATIC MACHINE CO., Inc.
Windsor Vermont

Agent for Michigan Territory:
J. C. AUSTERBERRY
932 Dime Bank Building
Detroit, Mich.

Unusual Capacity

Distinguishes "W & P" Planers. Designed to economically fill the needs of the modern shop—powerful, speedy, accurate—these machines turn out the maximum of fine work. Full range of sizes and several styles. Write us.

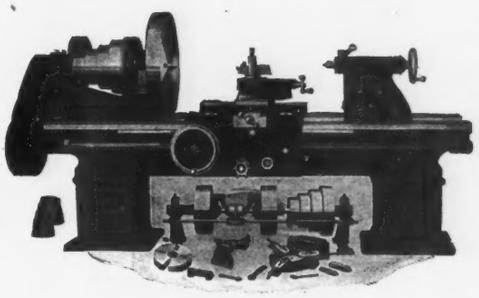
WOODWARD & POWELL PLANER CO.
WORCESTER, MASS., U. S. A.



No frills or needless ornament. Just a plain 11" lathe. An honest, dependable machine that will do more than most small lathes and "do it better." A1 material and workmanship.

C. F. DAVIS MACHINE CO., Inc.
133 ANDREWS ST. ROCHESTER, N. Y.
Also Manufacturers of Davis Keyseat Cutters

SOUTH BEND LATHE



South Bend Lathes Have Been on the Market Twelve Years

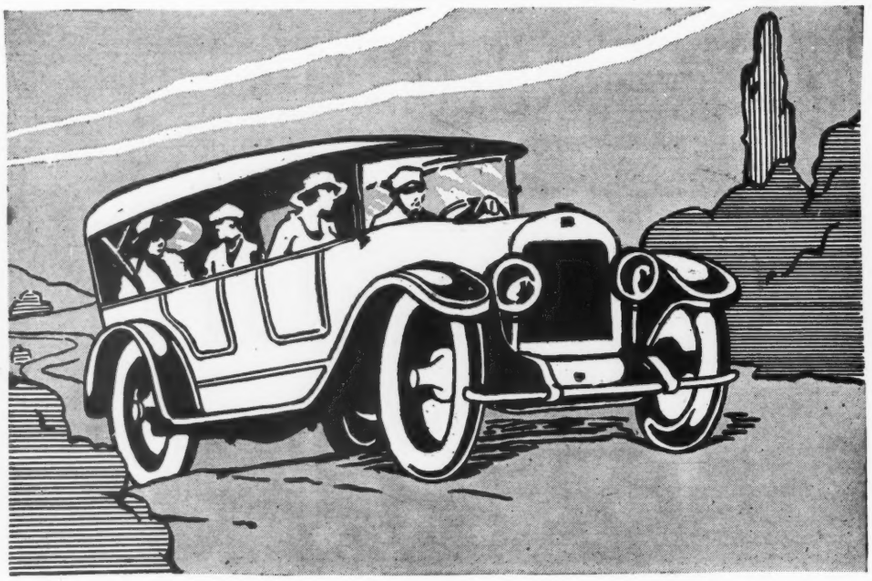
Swing Over Bed, Inches	Length of Bed Feet	Distance Between Centers, Inches	Hole Through Spindle, Inches	Approximate Weight on Skid	Code	
13¼	5	32	¾	1,000	Hasen	Prompt Delivery
15¼	6	40	1⅛	1,425	Jadin	
16¼	6	36	1⅛	1,700	Juddo	
18¼	8	57	1⅛	1,950	Kell	
21¼	10	75	1½	3,300	Penti	
24¼	12	95	1¾	4,420	Polly	

Made with straight or gap bed. Price includes all the equipment shown in illustration.

Many large, busy plants are increasing their production by using South Bend Lathes on duplicate work

Dealers in every large city. Send for free Catalog illustrating and describing entire line.

SOUTH BEND LATHE WORKS
420 E. Madison St. Established 1906 South Bend, Ind.



At Buick

The Part Brown Pyrometers Play in Great American Industries

Fourth of a series of talks showing how completely Brown Pyrometers cover the entire field of heat treating.

When Uncle Sam went to war a year ago, the great automobile industry instantly stepped forward offering its army trucks, Liberty Motors, motor parts, forgings and its immense wealth.

Hand in hand with its enlistment came Brown Pyrometers, redoubling its efforts, handling the heat treating, hardening and annealing—doing their full share in the gigantic work—standardized by such plants as Buick, Maxwell and Haines.

So here again is the prowess of Brown Pyrometers proven. They lead unconditionally. And what they have done is YOUR guarantee. Put them to the test in your plant now.

Shipped on 30 days' trial if you will. Write today for details to the Brown Instrument Co., Philadelphia, or one of their district offices in New York, Pittsburgh, Detroit, Chicago, or St. Louis.

Brown Pyrometers



Brown Pyrometers control the heat treating furnaces at the Buick Automobile Plant, Flint, Michigan.



The Brown Central Station Pyrometer shows signal man the right heats.



Why "SHELBY" Seamless Steel Tubing Saves Labor, Tools and Mechanics' Time

¶ In determining the various wall thicknesses, sectional contours, alloys and anneals of "SHELBY" Seamless Steel Tubing for Mechanical Purposes, the manufacturers have given much study to various problems associated with the ultimate use and the manipulation of this highly adaptable material.

¶ Standards of mechanical construction have been freely consulted; conditions of service have been considered; and comparisons have been made as to the feasibility of seamless tubing in certain work which hitherto had required material formed from solid stock after laborious effort.

¶ As a result, certain sizes and kinds of "SHELBY" Cold Drawn Seamless Steel Tubing are made which may be used with comparatively little or no special machining or finishing in numerous instances. Any variation in gauge will be found negligible and will require no correction except on work running into the very fine fractions of an inch or where a highly finished surface is required.

¶ The hollow construction reduces boring and drilling to their lowest terms—all that is required in most cases being a light reaming or surface finishing. Much labor is thereby eliminated and a consequent saving of time is effected. Tools are saved, as the amount of superfluous stock to be removed is considerably reduced when "SHELBY" Cold Drawn Seamless Steel Tubing is used in place of solid or forged stock, and that which is removed is of such uniformity that wear and tear on tools is of slight consequence.

¶ "SHELBY" Seamless Steel Tubing is made in a wide variety of special shapes such as hexagon, rectangular, oval, etc., which under ordinary circumstances would require considerable labor and time to produce from solid, round or square stock; these special shapes often being used as they are received from the mill, without additional machining.

¶ The advantages of "SHELBY" Seamless Steel Tubing for saving time, labor and tools are based on the inherent high qualities of the material from which it is made; the modern, accurate methods of manufacture pursued; and an appreciation of the requirements of present-day machine shops, tool rooms and industry in general.

¶ "SHELBY" Seamless Steel Tubing is maintained at the high peak of quality by a self-contained organization controlling the manufacture from ore to finished product. In awarding the Grand Prize, the Superior Jury of Awards, Panama-Pacific International Exposition, stated that "SHELBY" Seamless Steel Tubing represents "the highest development of the art." The significance of this statement is realized more fully by considering the amplitude of the line in which "SHELBY" Seamless Steel Tubing is manufactured.

NATIONAL TUBE COMPANY

General Sales Offices: Frick Building Pittsburgh, Pa.

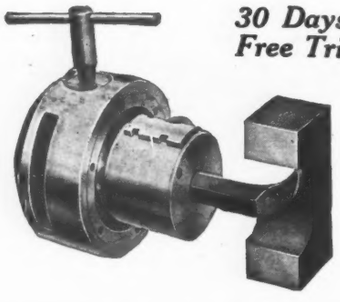
DISTRICT SALES OFFICES: Atlanta Boston Chicago Denver New Orleans New York Philadelphia Pittsburgh Salt Lake City St. Louis St. Paul

PACIFIC COAST REPRESENTATIVES: U. S. Steel Products Co., San Francisco, Los Angeles, Portland, Seattle

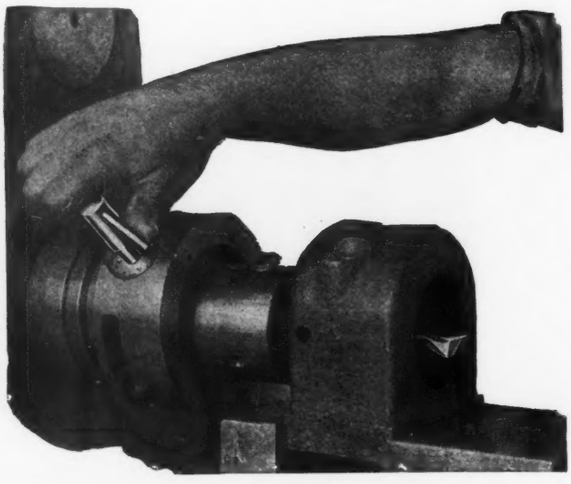
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are adapted for use on turret lathes, milling, drilling and boring machines. They may be quickly and accurately set to the size required by means of an adjusting screw, the whole device then locked as rigidly as a one-piece tool. One tool can bore any number of diameters within the range of adjustment—10 inches.



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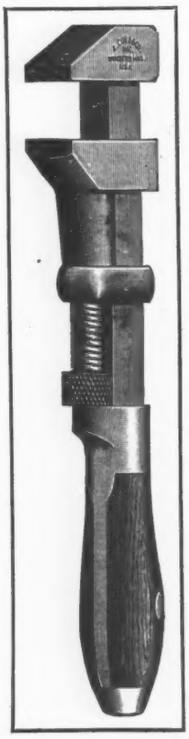


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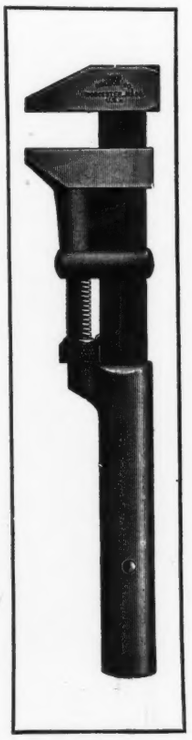
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Thirty per cent stronger, by actual test, than other wrenches. You may pay just a little more for a "Coes" Wrench, but your dealer will *show you* wherein the difference in price lies. A trial of a "Coes" will *convince you.*

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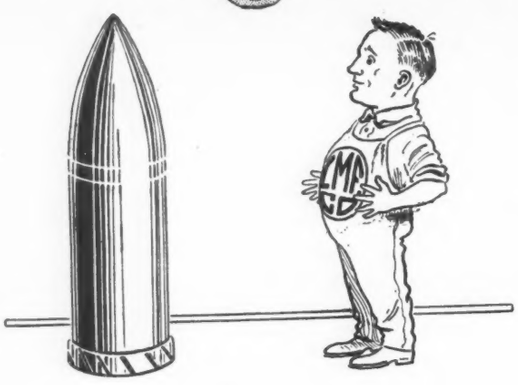
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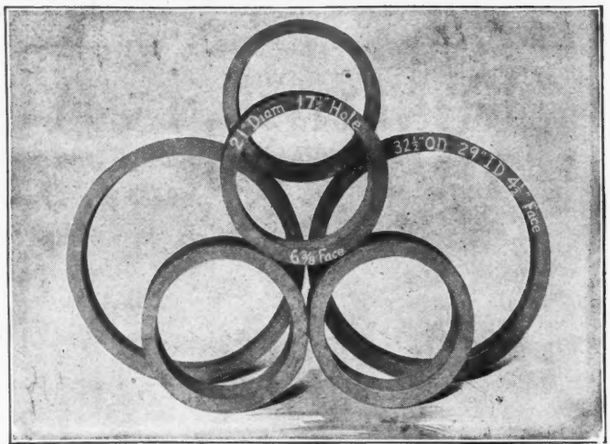
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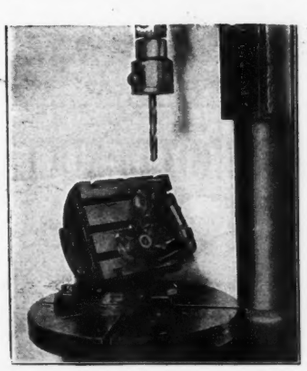
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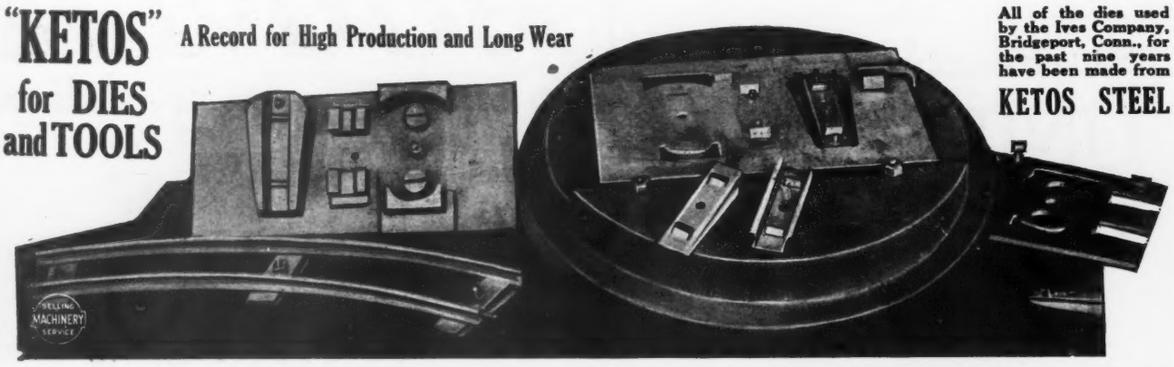
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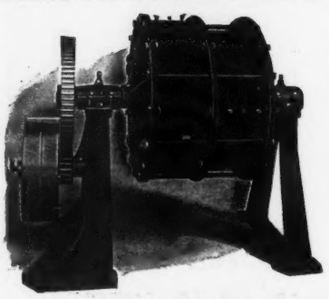
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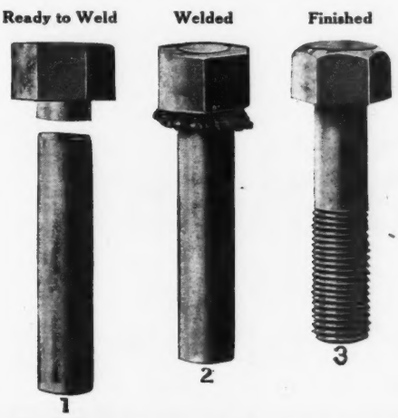
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HEADS ELECTRICALLY WELDED



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Will be pleased to submit samples and quote on your requirements.

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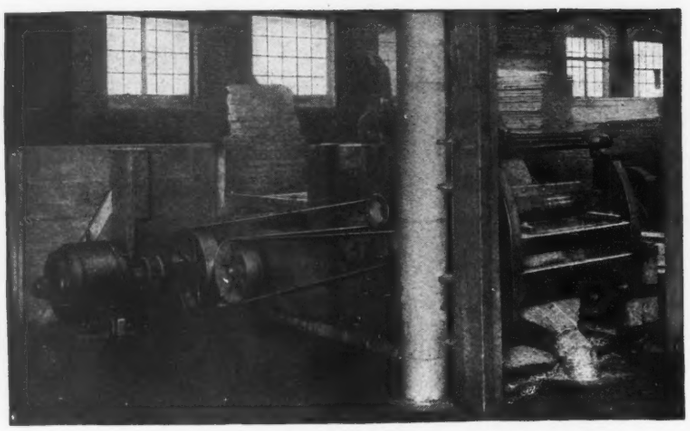
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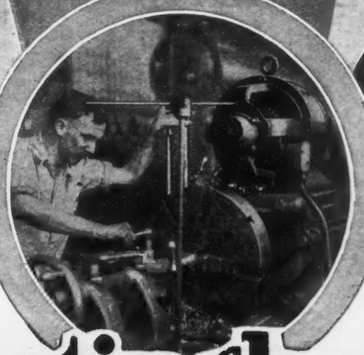
because it is suited to such widely diversified uses.

Let us send you Bulletin 11124, descriptive of "The Public Servant."

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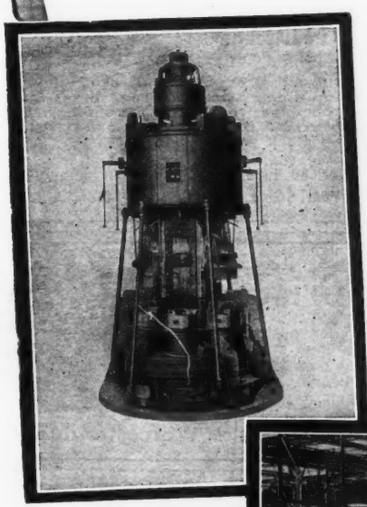
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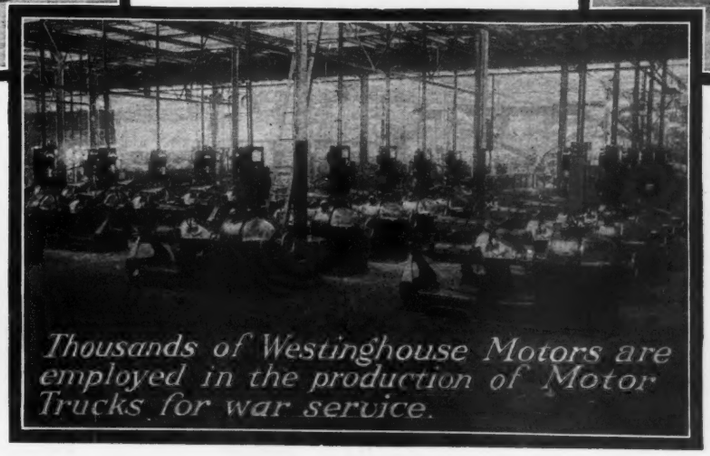
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When the machine tool builder and the motor manufacturer cooperate on the best manner and means of driving machine tools, the best results accrue to all concerned.

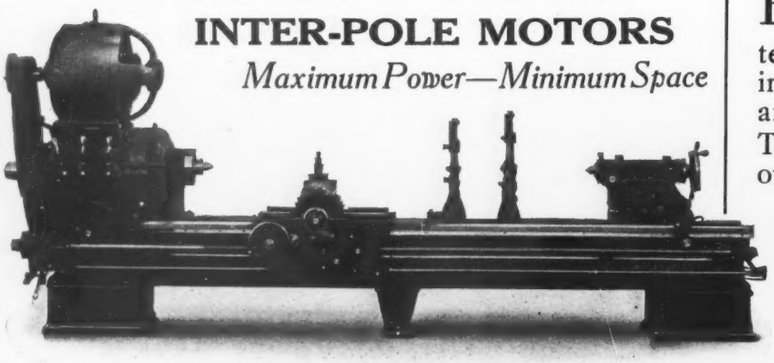
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Ideal Machine Tool Drive

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Maximum Power—Minimum Space



POWER, dependability and compact simplicity make Inter-Pole Motors the ideal drive in shops where time and space are important factors.

They will carry temporary overloads of fully 100 per cent and reverse from maximum speed in either direction within a few seconds.

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Licensed Under Burke Universal Motor Patent



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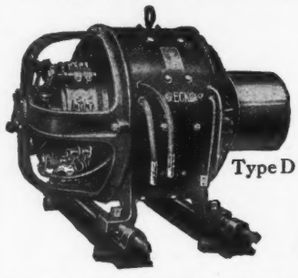
000 Drilling Capacity 1/4"
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No. 6 Electric Grinder.

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Type D

Sizes 40 H. P. and Smaller.

Unequaled Electrical and Mechanical Performancefor Machine Tool Applications.

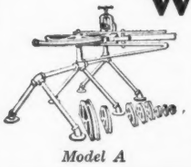
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PIPE, TUBING AND SOLID BAR BENDERS



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This Bench Grinder



is the F & M Motor Grinder, a simple, compact, convenient machine for the foundry, machine or blacksmith shop. It has dustproof ball bearing motor and takes 6" or 12" wheels.

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Portable
All sizes

Rope and Motor driven

No welding job is finished unless properly ground. Write today for details with illustrations.

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Binghamton, N.Y.
Oldest Portable Tool Manufacturers in America

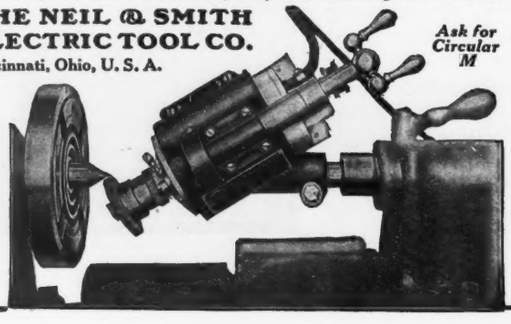
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Will grind lathe centers mechanically with scientific accuracy in fraction of time required with other methods.

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Ask for Circular M





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For the job that's beyond the bench or post drill—in construction or repair work—

Van Dorn Portable Electric Drill

is the solution.

Equipped with special Van Dorn motor, for direct or alternating current. Attach it to the nearest lamp socket and it's ready for high speed or heavy duty drilling.

What are you drilling, reaming or grinding? There's a Van Dorn Portable Electric Tool to do the work cheaper.

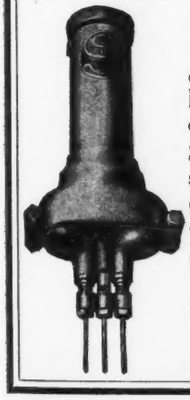
Our Catalog M and practical suggestions we will submit will prove helpful to you.

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The Van Dorn Electric Tool Co.
Cleveland, O.

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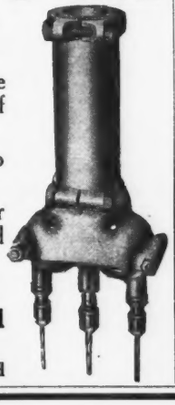


Sellew Adjustable Drill Heads

enable you to drill three holes at a time instead of one.

Special Heads made to suit your work.

Get in touch with us for the sake of economy and a greater output.

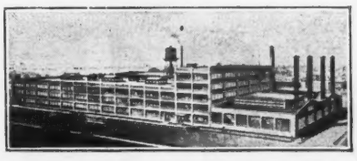


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Michigan oilers and grease cups insure efficient lubrication. Used by leading tool builders everywhere for the past 30 years.

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No. 2—6 Spindle Adjustable *Buhr* Patent Ball Bearing Drill Head

Adjustable Ball Bearing Drill Heads From 2 to 12 Spindles

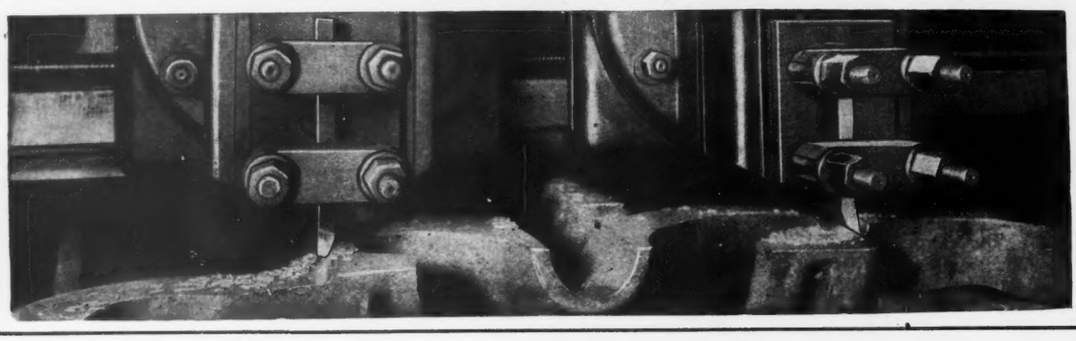
Fixed Center

Any Number of Spindles

NELSON-BLANCK MFG. COMPANY
DETROIT MICHIGAN

EUROPEAN OFFICE,
Coronation House, 4 Lloyds Avenue, London, E. C.
Gaston Marbaix, Factory Agent

URANIUM

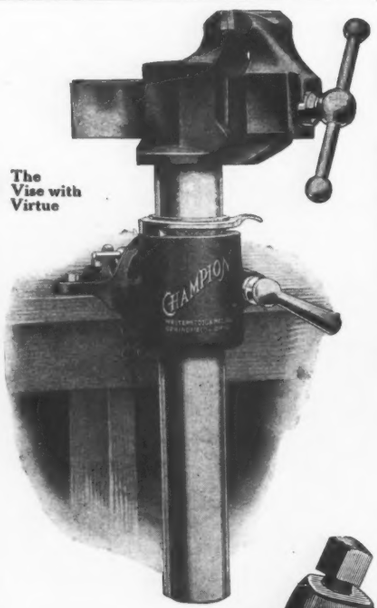


Uranium High Speed Steel makes good cutting tools for *any* service. The extra tough acid proof bronze pump castings shown in the accompanying photograph offer a fitting test of efficiency. Tools of Uranium High Speed Steel were *the only ones that "stood up" on this job.*

Write us or see your own dealer

STANDARD ALLOYS COMPANY

Forbes and Meyran Aves. **PITTSBURGH, PA.**



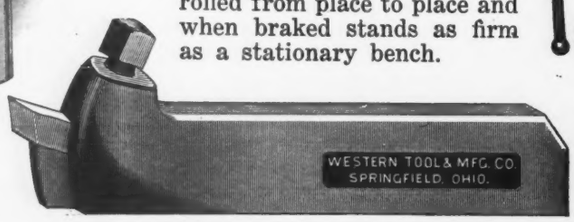
The Vise with Virtue

Champion Tools and Shop Furniture

Champion Tool Holders are large factors in the economy of high speed steel. The close up grip of the set screw and the heavy support under the cutting edge hold the tool rigid, prevent chatter, and permit using the steel to the last piece.

A versatile tool. **The Champion Vise** can be raised and lowered, and swiveled into almost any position. It holds odd shapes as well as ordinary work and a single lever locks it securely. Full line.

The Champion Vise Stand—a convenient, movable Vise Stand, Work Bench and Tool Tray combined. It is easily rolled from place to place and when braked stands as firm as a stationary bench.



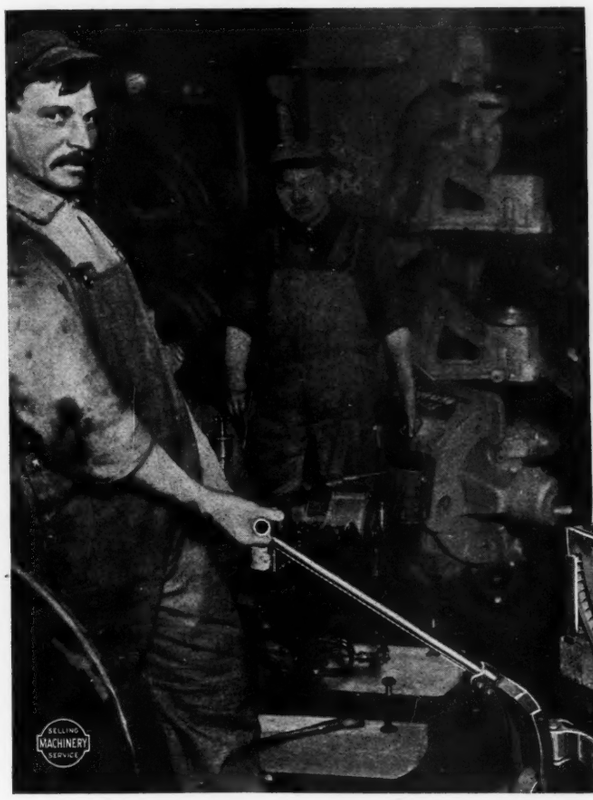


Catalogue of the full "Champion" Line on request.

THE WESTERN TOOL & MFG. CO.

SPRINGFIELD **OHIO, U. S. A.**

FOREIGN AGENTS: Alfred Herbert, Ltd., Great Britain, Italy, France, etc. V. Lowener, Copenhagen, Stockholm. Spliethoff, Beeuwkes & Co., Rotterdam. W. R. Grace & Co., Chili, Peru and Bolivia. LOCAL AGENTS: Any first-class Hardware House.



One Cowan Truck *and* Fifty Platforms *"Keep Things Moving"*



No Congestion or Confusion Here

The Terry Turbine Company of Hartford, Conn., do all their trucking with one Cowan Truck and about fifty platforms. One of these platforms, of special design, is shown carrying sixteen diaphragms to a machine, *where the loaded platform will be left.* With

THE COWAN TRANSVEYOR
TRADE MARK REG. U.S. PAT. OFFICE

work may be moved to a series of operations, stored and shipped without re-loading. This is the unit system of transveying. It is an effective means of increasing production through the reduction of handling charges and the elimination of disorder and delay.

THE unit system of transveying and some of its striking possibilities are fully explained and illustrated in our catalogue. Let us send you a copy.

THE problem of moving and storing material is receiving close attention to-day as a field for greatly improved methods. As a result the Cowan system is coming into its own, and our transveyors are being used in every phase of shop work.

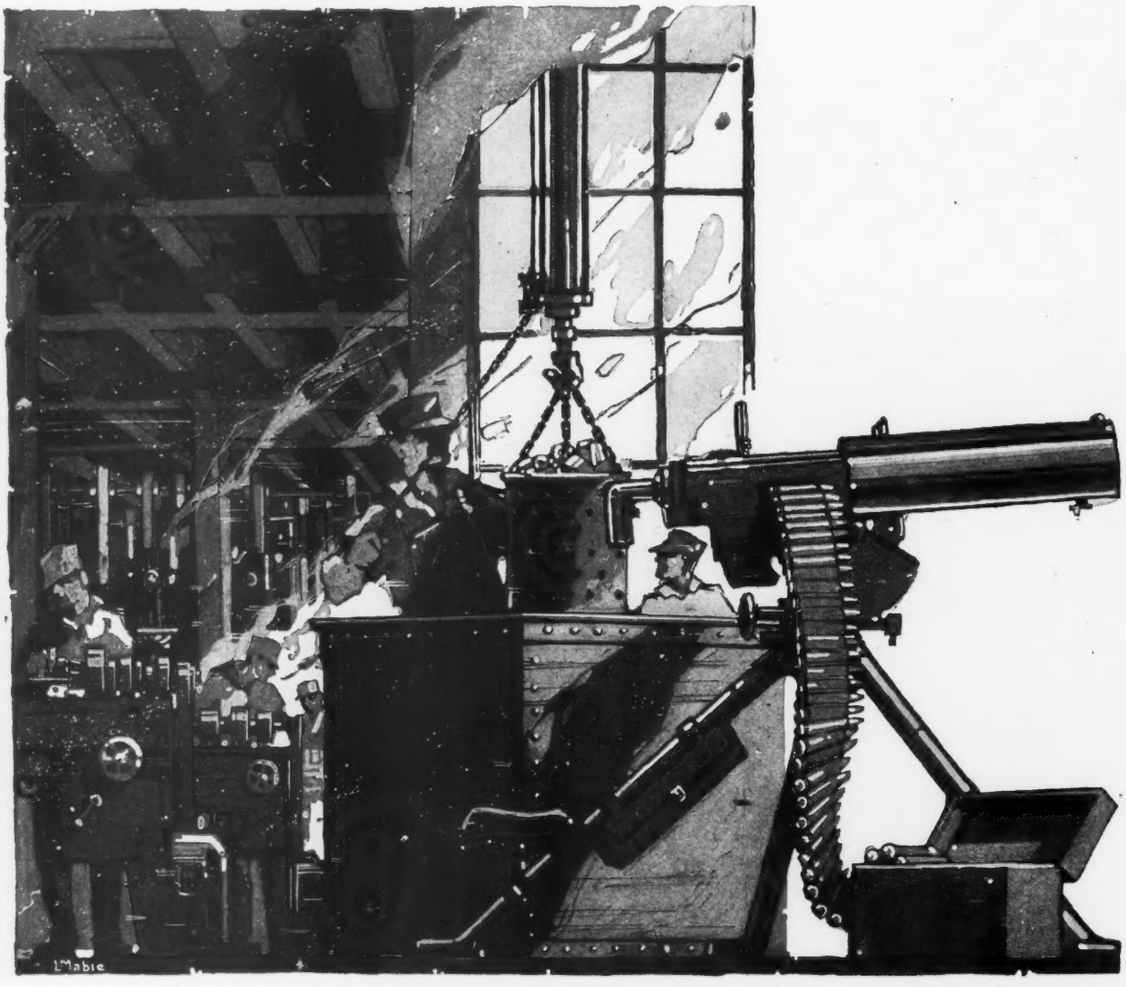
How are you moving your material?



Cowan Truck Company

Makers of the Cowan Transveyor

88 Water Street Holyoke, Mass., U.S.A.



OAKITE CLEANS

Machine Gun Parts, Cartridges, H. E. Shells and all types of Munitions.

OAKITE Materials backed by OAKITE Methods will speed up your production and eliminate cleaning troubles.

Write for Booklet 857. It tells how.

OAKLEY CHEMICAL CO.

26 Thames Street **New York**


COCHECO
BELTING
Keep the
Shop Belts
Turning
Speed Up
VICTORY
Don't run the risk
of a shut-down—a delay that
may count dearly on material urgently
needed. Don't take a chance on equipment
that hasn't proved itself dependable.
Cocheco Belting—tanned by the slow-but-sure white oak
bark process, curried, stretched, stripped, properly matched
and inspected all along the line—can be depended on to keep
the shop belts turning.
Cocheco Belting is Quality Belting—sold on merit. Ask for more information.
I. B. WILLIAMS & SONS, Dover, N. H.
BOSTON, MASS., 157 Summer Street NEW YORK, N. Y., 71-73 Murray Street CHICAGO, ILL., 14-16 N. Franklin Street

THE NEW GENESEE FACING TOOL

Chip space never varies, no matter how often blades are ground, nor does the tool once set in machine have to be removed for grinding. Blades are simply replaced in slots and are automatically aligned. No special holder is needed for grinding them. Blades will outwear three to five solid tools and may be replaced at small cost. Made in 4 sizes—each size takes a variety of pilots.

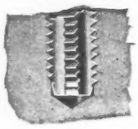


For Greater Economy in Facing, Counter Boring, Etc.

Ask for full details

GENESEE MFG. COMPANY **ROCHESTER, N. Y.**

Of What Does This Remind You?



SUPPOSE that you had on hand when your last tap was broken a commercial device built specially to remove the broken pieces of tap, a commercial device not a home-made article, would you not have saved a great deal of time?

Write us for information

The Walton Company
Hartford, Conn.

ANY DRONES IN YOUR HIVE?

Every machine in the shop that is not working to capacity is losing money. The busy bee to keep the taps humming with work and the shop with profit is the

Bicknell-Thomas Tapping Attachment



It permits the operator, by merely raising the drill spindle, to reverse the tap at twice the tapping speed, while the spindle continues full speed ahead.

Two sizes—for taps from 3/16" to 3/8" and 5/16" to 3/4" respectively. Write for details.

BICKNELL-THOMAS CO.
GREENFIELD, MASS.

Don't Judge By Appearances



In selecting equipment—especially threading tools—don't forget that the final grinding and polishing gives all tools a clean-cut, efficient appearance—whatever their quality. In judging

BAY STATE TAPS AND DIES

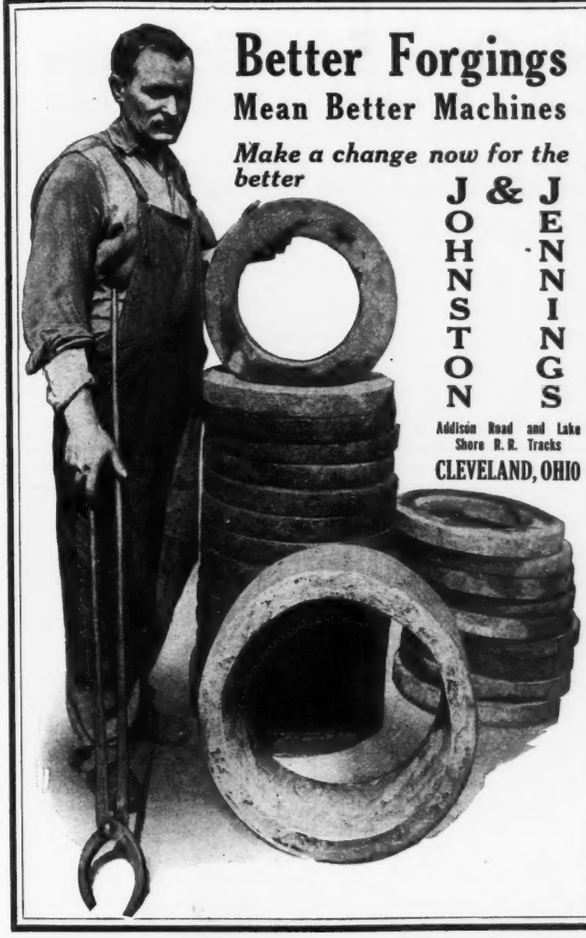


remember that these finishing touches cover uniformly A-1 products, guaranteed accurate and durable from the core out by a firm of national repute.

You'll find a trial order the most convincing proof

BAY STATE TAP & DIE CO., Mansfield, Mass., U. S. A.

REPRESENTATIVES FOR ENGLAND: Geo. W. Goodchild & Macnab, 56-58 Eagle St., Southampton Row, London, W. C. REPRESENTATIVES FOR SCANDINAVIA: Wilh. Sonesson & Co., Ltd., Malmo, Sweden.



Better Forgings
Mean Better Machines

Make a change now for the better

J & J
JOHNSTON & JENNINGS

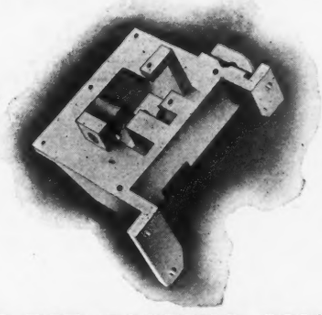
Addison Road and Lake Shore R. R. Tracks
CLEVELAND, OHIO

GUARANTEED FORGINGS
for all
MACHINE PARTS

Wyman-Gordon Company
Worcester, Mass. Cleveland, Ohio

PHOENIX DIE CASTINGS

Produced in an up-to-date plant with all modern facilities



Send us samples or specifications for estimate

PHOENIX DIE CASTING COMPANY
21 Illinois Street BUFFALO, N. Y.

THRIFT

One of the lessons the war is teaching is thrift. Slowly but surely—in many cases against their wills—the people of America are learning the value of that homely virtue.



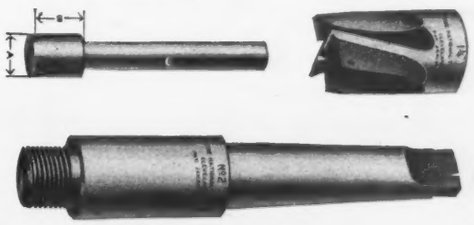
NATIONAL
Patent Interchangeable Counterbores

prove how easily and with what advantage thrift may be practiced in the small tool field.

The National Patent Counterbore is made in three parts — only the cutter (one-quarter of the whole tool) being of high-speed steel. The shank and pilot are made of more durable and less expensive steel—a clear saving of 75 per cent of tungsten on the initial investment.

When the cutter is replaced, the contribution to the scrap heap is small—especially as the spiral flutes, which give a shearing cut, extend well back, so that — barring accident — the tool can be used till two-thirds of its length has been ground away. The shank and pilot are rarely subjected to strain and outlast any number of cutters.

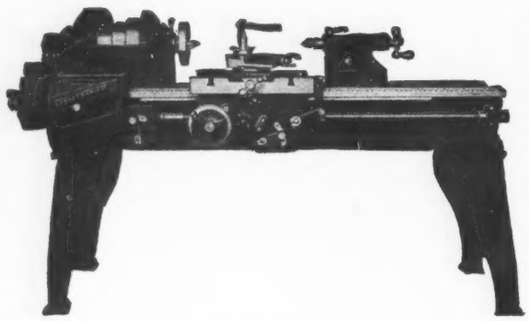
Full description in Bulletin.



Manufactured by

THE NATIONAL TOOL COMPANY
CLEVELAND, OHIO, U. S. A.

CHICAGO OFFICE: 24 SOUTH JEFFERSON STREET
PHILADELPHIA OFFICE, 11 NORTH 6th STREET



Read Our Specifications

Before going ahead get a copy of our specifications of this 14″ engine lathe. It's a

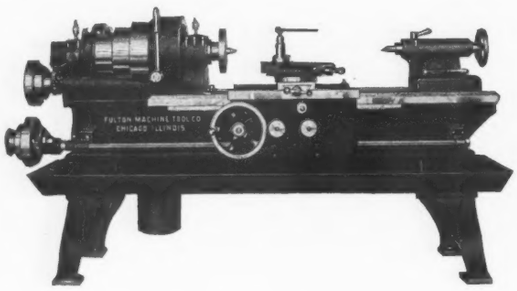
CARROLL-JAMIESON Screw Cutting Lathe

It has double back gears, quick-change gears giving thirty-two changes of feed without removing a gear, nine spindle speeds, 2½″ belt drive from three-step cone.

Drop a line now for a set of specifications.

THE CARROLL-JAMIESON MACHINE TOOL CO., 257 Davis St., Batavia, Ohio

George H. Alexander, Coleshill Street, Birmingham, England, Selling Agents in the British Isles.



FULTON HEAVY DUTY MANUFACTURING LATHES

are tools of unusual power and speed, strongly and simply constructed and easy to operate.

Swing 18¼ inches—7 ft. bed. Plain or friction head as desired.

Complete details upon request

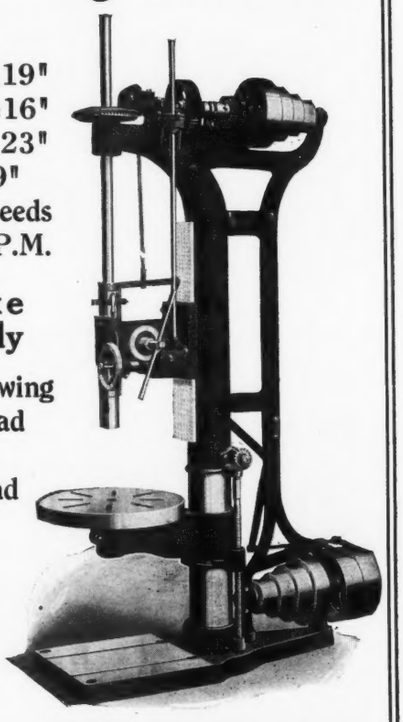
Fulton Machine Tool Co.
1438 BRYAN PLACE CHICAGO, ILL., U. S. A.

Sibley Sliding Head Drill

24" Swing
Max. Height 119"
Table Traverse 16"
Head Traverse 23"
Spindle Feed 9"
8 Spindle Speeds
16 to 294 R.P.M.

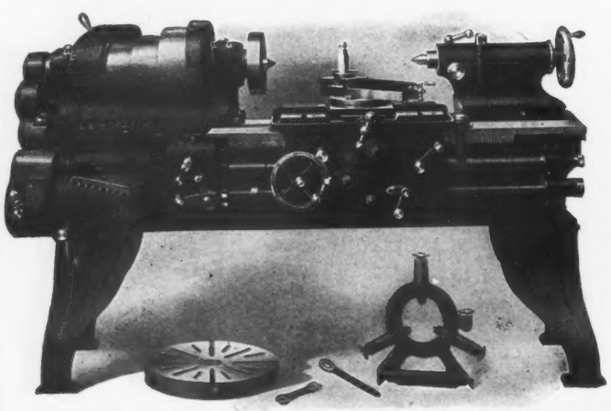
We Make Drills Only

16" to 30" Swing
Stationary Head
Sliding Head
Traveling Head
High Speed
Sensitive



Write for Catalog

SIBLEY MACHINE CO.
8 Tutt Street South Bend, Ind., U. S. A.



16" Lehmann Lathe Swings 18¼"

We Also Make

18" Lehmann Lathe—Swings 20¼"

Built for Heavy Duty and Accuracy

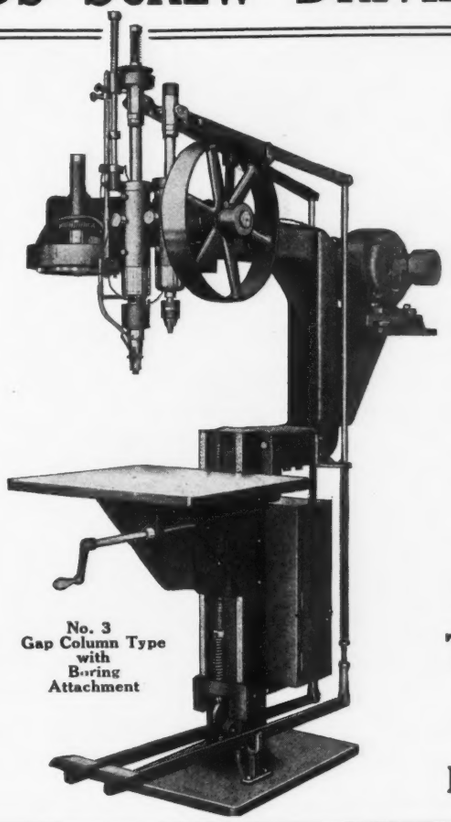
3-STEP CONE for 3″ belt, DOUBLE BACK GEARS, CHILLED BED, HIGH CARBON STEEL SPINDLE, PHOSPHOR BRONZE BEARINGS, DOUBLE PLATE APRON STEEL GEARING, BALL THRUST BEARING for lead screw, cuts threads 2 to 112 to the inch without change of gears, GEARED FEEDS from .007 to .4. 9′ bed takes 5′ between centers, net weight 3020 lbs. on 16″ lathe. *Write for circular illustrating NEW and INTERESTING FEATURES of these lathes.*

LEHMANN MACHINE CO., 606 to 612 So. Broadway ST. LOUIS, MO.

THE REYNOLDS SCREW DRIVING MACHINE

BILLIONS of screws are being driven every day in the nation's work-shops. And Millions of these Billions are driven at top speed and low cost with

THE REYNOLDS SCREW DRIVING MACHINE



No. 3 Gap Column Type with Boring Attachment

MAGAZINE fed, automatic and adapted to set screws of any size in wood or metal, these machines are an economy in the large or small shop. They can be handled by unskilled labor, are carefully built to give long service and can be furnished in a number of sizes and types.

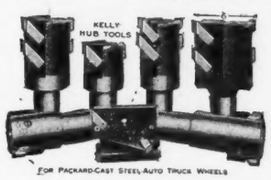
Used in U. S. Arsenals and Navy Yards on gun parts and war work of many kinds. See Catalog for Details.

THE REYNOLDS MACHINE CO.

Successors to Reynolds Pattern & Machine Co.

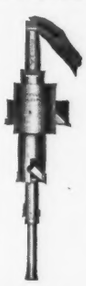
Massillon, Ohio, U.S.A.

KELLY PRODUCTION TOOLS



FOR CYLINDERS, CRANKCASES, CONNECTING RODS, AUTO PARTS, ETC.

They **"ADJUST"**



We make **DELIVERIES** in 1 to 10 days

Write for the catalog G-3

THE KELLY REAMER CO.

CLEVELAND, OHIO, U. S. A.

Burton, Griffiths & Co., Ltd., London, English Agents
Burton Fils, Paris, French Agents 40 Domestic Agencies

KELLY "Multiple" 7 Operations

Bruno Slotting Attachment

It's new—it's good—and it fills a long felt want. This attachment machines any shaped surface—inside or out with equal accuracy. No interfering tool post—no vibration at any speed. A valuable addition to any planer or shaper.

Send for details

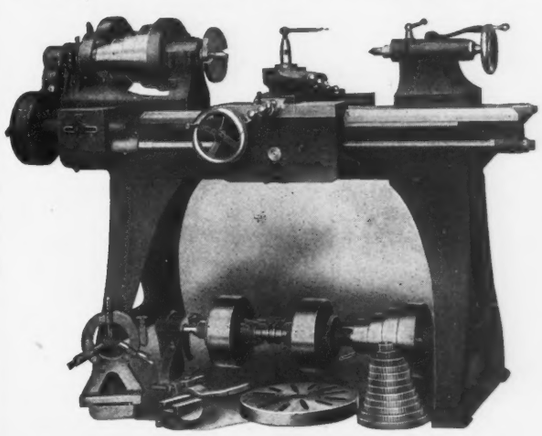
Made in 3 sizes, ½ in., ⅝ in. and ¾ in. round shank tool capacity.



BRUNO MANUFACTURING CO.

61 Terrace Street BUFFALO, N. Y., U. S. A.

The Worcester "Thirteen"



Worcester 13" Manufacturer's Lathe has all the attributes of the Worcester line in general.

It is a compact, rigid machine, without complicated parts, and guaranteed to do accurately and quickly all the work that is within its range.

If you need a small Lathe it will be to your advantage to send for our Circulars.

WORCESTER LATHE COMPANY

68 Prescott Street WORCESTER, MASS.

Cut Metal Economically



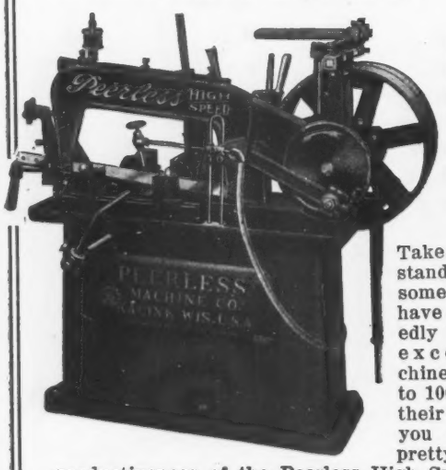
Catalog gives sizes and full data

The special feature of the "Racine" High Speed Metal Cutting Machine — the Return Stroke Lifting Device — saves your saw blades and increases production. The saw frame is automatically held in any position, thus providing for convenient handling of stock no matter what its size may be.

The "Racine" High Speed Metal Cutting Machine is a consistent machine, built for speedy and uniform work.

RACINE TOOL & MACHINE COMPANY, 250 Fifteenth St. **Racine, Wis., U. S. A.**

Peerless HIGH SPEED



A New Standard in Metal Cutting Increases Production 50% to 100%. Saves in Time, Labor and Material.

Take the older standard saws, some of which have been deservedly regarded as excellent machines and add 50 to 100 per cent to their output, and you will come pretty close to the productiveness of the Peerless High Speed. It has created a NEW standard of production which is all its own.

Repeat orders tell the story. Some of them come from manufacturers who have had to wait for Peerless machines when they could get others at once, paying heavy express charges to get them quickly.

The Peerless High-Speed saves in time, labor, blades and material. It cuts faster, with a thinner blade, with less attendance and with a smaller consumption of saw blades than any other metal saw made.

Order a "Peerless" on 30 days' trial. We pay freight BOTH WAYS if it fails to make good.

PEERLESS MACHINE COMPANY
1611 Racine Street **RACINE, WISCONSIN**

The HIGLEY

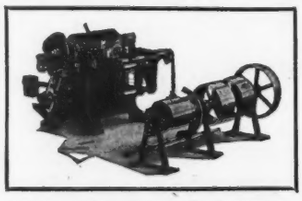
COLD METAL SAW

Catalog furnished by

Vandyck Churchill Co.

New York **Philadelphia** **New Haven**

Crescent Wood Working Machinery



will largely compensate for shortage in labor at this time, and you owe it to yourself to investigate this splendid line of wood-working machinery right away.

Ask for free catalog of band saws, jointers, saw tables, planers. planers and matchers, disk grinders, swing saws, post borers, shapers, variety wood workers, hollow chisel mortiser, universal wood workers.

THE CRESCENT MACHINE CO.
56 MAIN STREET **LEETONIA, OHIO**



The Holes in These Parts Were Made on the



DETROIT Semi-Automatic Driller

The Detroit Semi-Automatic Driller can't be beaten for drilling small holes rapidly and accurately. All the operator is required to do is remove and insert stock at each of the five spindles in succession. Drill breakage is reduced to a minimum. Positive lubricating system insures quick, clean cutting.

Send for Complete Details

DETROIT TOOL CO., DETROIT, MICH.

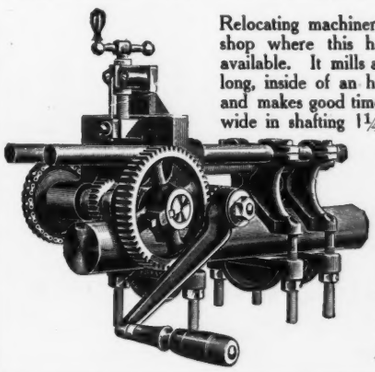
A Single Fact

is worth a ship-load of argument. The fact that well known manufacturers in many lines place reorders for Kelly Shapers as their business grows carries more conviction than a bookful of statistics, though these are also available in our catalog—a complete description of all seven sizes of

Kelly Crank Shapers

R. A. KELLY CO., Xenia, Ohio, U.S.A.

The Burr No. 1 Portable Shaft Keyseater



Relocating machinery is not a bugbear to the shop where this handy emergency tool is available. It mills a ¾" x ⅜" keyseat, 12" long, inside of an hour—without resetting—and makes good time on any size up to 1⅛" wide in shafting 1¼" x 5" diameter.

Well made, simple to operate and works in close quarters. Catalog for details.

John T. Burr & Son
429 KENT AVENUE
BROOKLYN, N. Y.

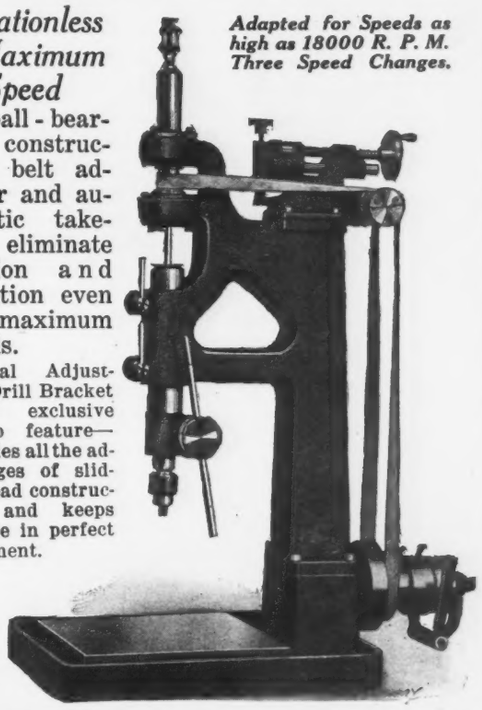
DEMCO BENCH TYPE HIGH SPEED DRILL

Vibrationless at Maximum Speed

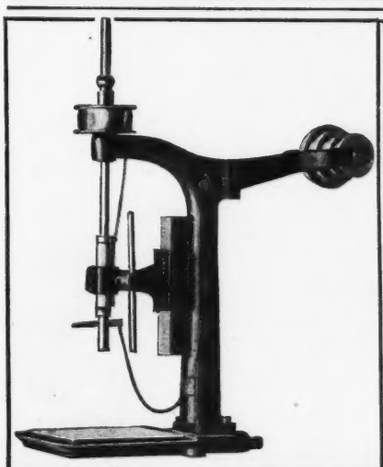
All ball-bearing construction, belt adjustor and automatic take-up eliminate friction and vibration even at maximum speeds.

Vertical Adjustable Drill Bracket—an exclusive Demco feature—provides all the advantages of sliding head construction and keeps spindle in perfect alignment.

Adapted for Speeds as high as 18000 R. P. M. Three Speed Changes.



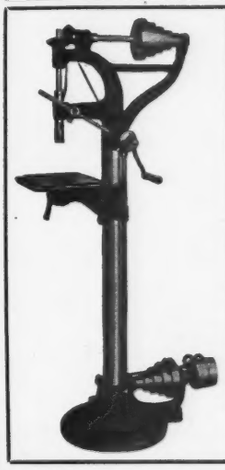
DEMCO MACHINE TOOL CO.
CLEVELAND, OHIO, U. S. A. Successors to The DeMeoy Machine Co.



BENCH DRILLS

1-4 Spindles
½" Capacity
Lever and Power Feed
Powerful
Accurate
Durable

FRANCIS REED COMPANY
43 Hammond St.
Worcester Mass.



THE LINDGREN

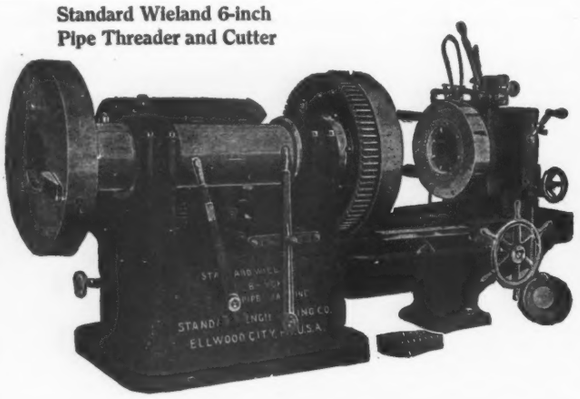
13-Inch High Speed Drill

All bearings are bronze bushed and provided with ring oilers. The spindle has ball thrust bearings. The sleeve is graduated in inches.

New lubrication features
No leakage of oil

F. W. LINDGREN CO.
ROCKFORD ILLINOIS, U. S. A.

Standard Wieland 6-inch
Pipe Threader and Cutter



Thread Pipe Do You? How?

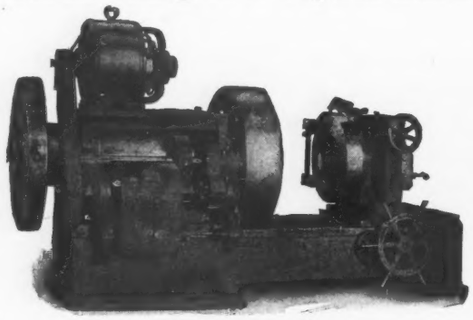
The modern, efficient way is the Standard Wieland way, with a heavy, sturdy, durable machine, simple and positive in operation, fast and accurate in production. This machine costs more and is worth it; character and quality of output prove it.

A few features: One-piece bed; single-speed pulleys; gear speed changes through semi-steel cut gears; deep chasers, cutting long taper threads in one cut perfectly, steel as well as iron pipe.

Send for the circular.

Standard Engineering Company
Ellwood City Pennsylvania
San Francisco Office: 1801 Claus Spreckels Bldg.

The Method of Drive is an Important Thing in a Pipe Machine



Because a lot of time is wasted if the speed is not just right for every size and material of pipe

The "Stoever" Pipe Machine

has a single-pulley drive with gear speed variation. This means that the **belt speed is constant,** not lowest when it should be highest. **The belt tension is always proportional to the power transmitted**—economy of power. **The belt contact is constant and always adequate.**

The "Stoever" has a friction countershaft which eliminates shifting belts and saves at least one-third in belting cost.

The gear speed variation affords a speed exactly right for every size of pipe, and for iron or steel. **This means maximum cutting and threading speed.**

Write for the "Economy" Booklets.

TREADWELL ENGINEERING CO.
Sales Office: 140 Cedar Street, New York
Works: Easton, Pa.

TE 10

Quick! Accurate! Economical! **-HURLBUT-ROGERS**



It will pay you to investigate. Booklet on request.

THE two cutting tools of the Hurlbut-Rogers machine double the speed and halve the cost. In addition, one tool acts as a rest for the other and pressure being identical on both sides, the stock is held absolutely rigid and true. Capacity up to 10″.

The Hurlbut, Rogers Machinery Co.
South Sudbury, Mass.

MERRELL
Pipe Threading and Cutting Machinery.

Hand or Power Operated

THE MERRELL MFG. CO.
15 CURTIS STREET TOLEDO, OHIO

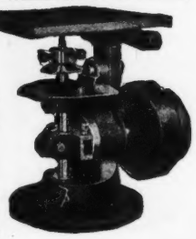
Tuttle Tappers on Brass

The Tuttle Tapper is tapping 10/32″ holes in brass guide arms for flush valves at the rate of *300 per hour* in a Trenton plant. If *you* would improve production, write us.

PARAGON GEAR WORKS, Taunton, Mass.
Evans Stamping & Plating Co.

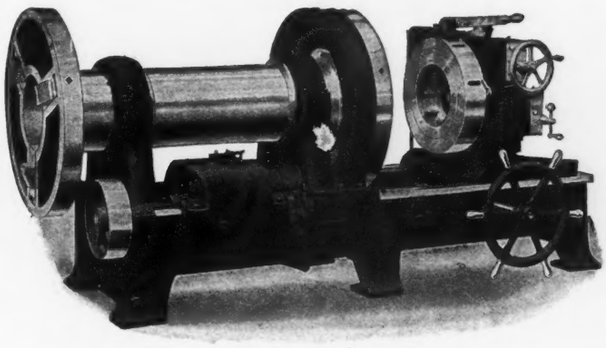
A "HARTFORD" Die Filing Machine

accomplishes many times more work than hand filing, at the same labor cost, and does it with greatest accuracy. More details on request.



THE ROBINSON TOOL WORKS, Inc.
Waterbury, Conn., U. S. A

PEERLESS B&K DUPLEX P·D·Q·C



No Waste Here

How much time do you spend *getting ready* to do the job? For instance—how long does it take to get ready to change the dies in your pipe machines? In the B & K machines no time is lost removing a lot of screws or the cover—then after the dies are removed you can clean the die slots so easily without more lost time.

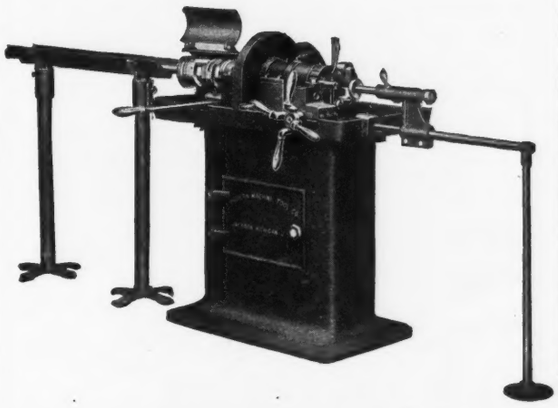
The construction of the Peerless Die Head is such that all waste motion is eliminated. And the die head is backed by good chucks (three styles,) good gear-box and oiling system. All these go to make up a satisfactory pipe machine.

May we send you a catalog?

BIGNALL & KEELER MACHINE WORKS

EDWARDSVILLE ILLINOIS, U. S. A.

Cutting-Off Machines



THE MODERN CUTTING-OFF MACHINE

will cut Galvanized Pipe, Brazed Tubing, Welded Tubing, Butted Tubing, Seamless Tubing, any thickness of wall, quicker and cheaper than by any other method. Regular "Lathe Cut."

MODERN MACHINE TOOL CO.

JACKSON MICHIGAN, U. S. A.

FORBES

PIPE CUTTING THREADING MACHINES

Forbes Pipe Cutting and Threading Machines are highly developed, self-contained machines particularly adaptable for shops where speed and accuracy in pipe operations are desirable. Our 35 years' experience in pipe machine manufacture insures their correctness.

They are strong and simple, have few moving parts, are easily portable and require minimum floor space.



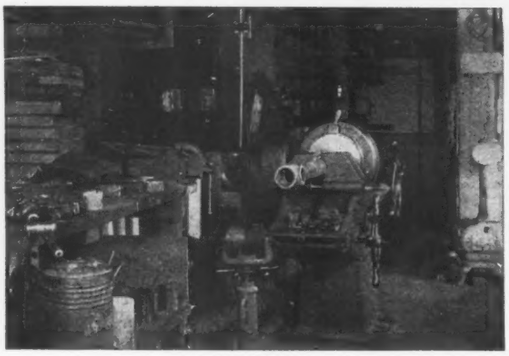
Capacity up to 15"

Write for catalog and prices

The Curtis & Curtis Co.

8 Garden Street Bridgeport, Conn.

Pipe Threading in close quarters



Many a concern has no space for a bulky machine, so they stick to hand-threading. It certainly doesn't take a large room to hold the Oster shown here.

OSTER

Combination
THREADING MACHINES

Thread straight pipe, bent pipe, bolts and nipples—even close nipples—they all come out of this machine easily and accurately threaded—ready for quick fitting into tight, accurate joints.

Besides that, it transforms a pile of scrap pipe into money by threading it into nipples in its spare time, and a boy can easily do the work.



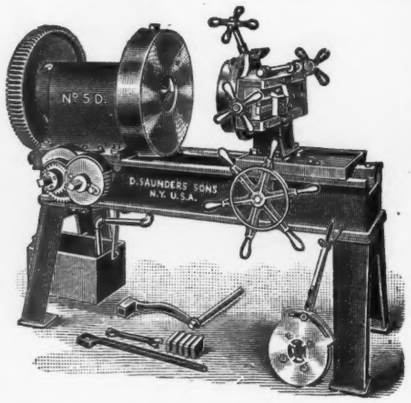
304-A

Threads pipe and nipples from 1 to 4 inches, bolts from ½ to 1⅜ inches. Made in three other sizes.

Send for this booklet, "Actual Pipe-Threading Experiences." In it satisfied users tell how they reduced costs and increased output at the same time. This booklet, and the Oster Catalog, are free—write today.

The OSTER Mfg. Co.
2107 E. 61st Street, Cleveland, Ohio, U.S.A.

SAUNDERS



No. 5D Pipe Threading and Cutting-Off Machine

Simple, compact and fully self-contained, this well constructed "Saunders" operates by hand or belt power—threads and cuts off pipe up to 6 inches diameter without stopping the machine. It is equipped with standard universal or three jawed Independent Gripping Chuck and adjustments for automatically centering and steadying the work.

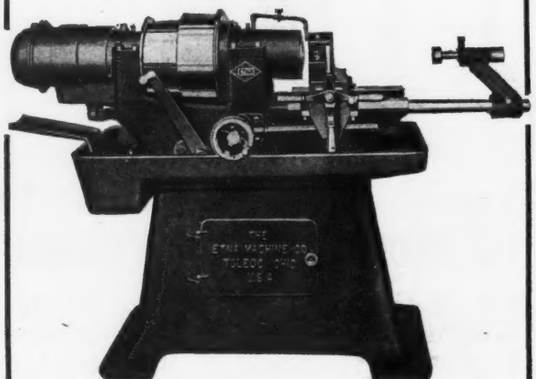
Catalog "P" gives all details, describes the whole line—capacity up to 18 inches—also our Patent Adjustable Expanding Die Heads with Interchangeable Chasers.

D. SAUNDERS' SONS
YONKERS NEW YORK, U. S. A.

The 3 Inch "Etna"

Capacity for continuous operation makes Etna Cutting-off Machines big producers—rigid construction insures their durability.

This 3 inch model has 10 and 12 inch cone diameters, two 11 inch friction pulleys and carries a 5 inch belt.



Capacity: 3" Round, 2" Square, 2½" Hexagon

Complete Description on Request

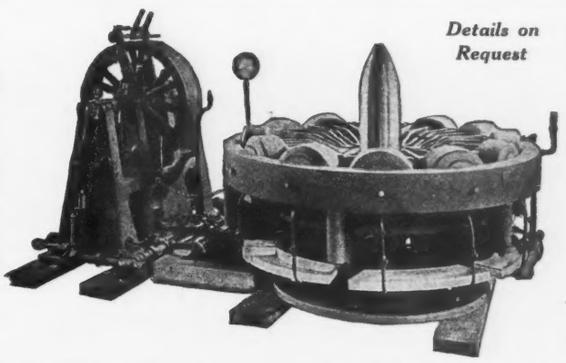
The Etna Machine Co.
Maplewood Avenue and Castle Boulevard
TOLEDO OHIO, U. S. A.

U. S. Government Requirements and the Machine Which Meets Them
The Hydraulic Banding Machine

Goods manufactured for the U. S. Government must comply with regulations. For instance, the bands on shrapnel shells and other projectiles must enter the grooves without shearing.

The Hydraulic Banding Machine is designed with this requirement in mind and operates with unfailing accuracy in this respect. It is a rapid producer, economical and adapted to a wide range of general compressing operations.

Details on Request



All Sizes for Shells up to 16 Inches

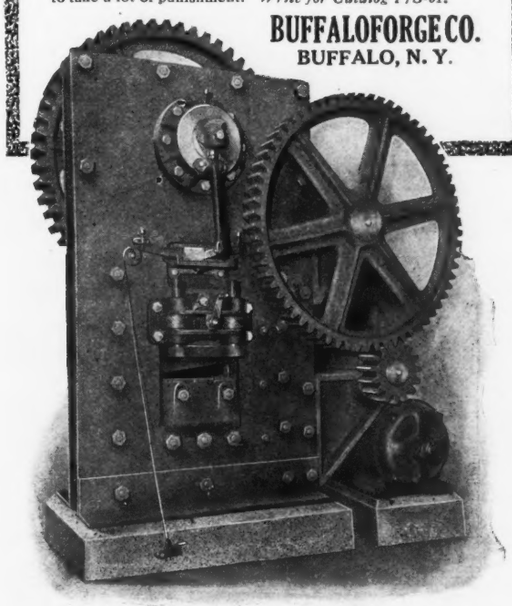
THE WEST TIRE SETTER COMPANY, Rochester, N. Y., U. S. A.

BUFFALO ARMOR PLATE

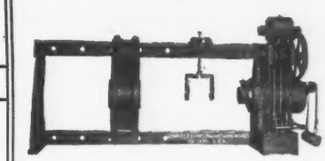
PUNCHES, SLITTING SHEARS, and BAR CUTTERS are dependable. They are built of "Armor Plate" steel - tensile strength 75000 lbs. per square inch 7½ times as strong as cast iron.

That means a lighter and stronger machine—a machine built to take a lot of punishment. *Write for Catalog P/S-51.*

BUFFALOFORGE CO.
BUFFALO, N. Y.



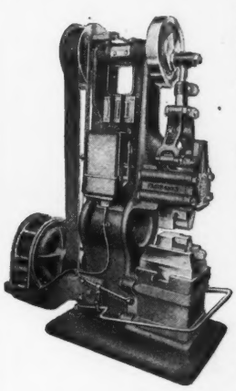
ELMES



Wheel Presses
Forcing Presses
Broaching, Bending
and
Straightening Presses

ESTABLISHED 1861

CHARLES F. ELMES ENGINEERING WORKS
222 No. Morgan Street, Chicago, Ill.



FAIRBANKS HAMMERS

25 to 300 lbs.
BELT OR MOTOR DRIVE

These Hammers Embody a Design and Workmanship that are unsurpassed.

Send for Catalog

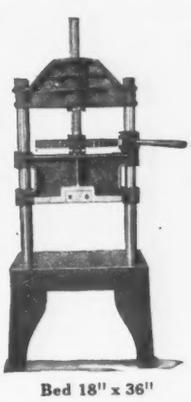
UNITED HAMMER CO.
OLIVER BLDG. BOSTON, MASS.

Toolmaker's Time Is Expensive
DON'T WASTE IT!

The Manhattan Screw Press

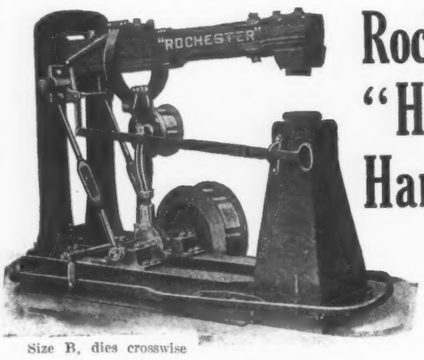
is a one-man machine with which to secure perfect alignment of punch and die; is sensitive and powerful in operation and a big time-saver. Note abundant room between bed and ram. *Convenient handling another feature.*

Circular gives particulars.



Manhattan Machine & Tool Works
Grand Rapids, Mich.

Bed 18" x 36"



Size B, dies crosswise

Rochester "Helve" Hammers

6 Sizes
8-30 Lbs.

Rochester Helve Hammers are adjustable for length of stroke while running, have non-crystallizable I-beam frames and separate, heavy weight anvils. Long stroke provides for handling larger work than other hammers of the same head sizes and the springy forging blows delivered by the solid hickory helves combine advantages of forging and drop hammers—do special die work which cannot be duplicated by hand.

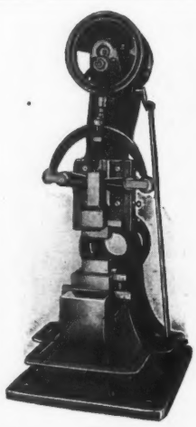
Details of full line in Catalogue.
Investigate our Manufacturing "Special."

THE WEST TIRE SETTER CO.
ROCHESTER N. Y., U. S. A.

DROP PRESSES
for All Purposes Our Specialty

The Peck Drop Lifter can be readily applied to foot or hand drops.

MINER & PECK MFG. CO.
Proprietors of the PECK DROP PRESS WORKS
NEW HAVEN CONN., U. S. A.



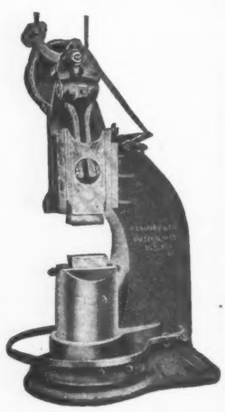
"DEAD STROKE" POWERHAMMERS

Strike a square, true blow at all times and can be safely run at high speed.

The peculiar feature is the spring, to which the ram is attached by a flexible belt, permitting a far more effective blow than can be given by any other hammer of the same weight and stroke, and requiring less power.

Built in 7 sizes. Write for circulars.

MANUFACTURED BY
Dienelt & Eisenhardt, Inc.
1304 No. Howard Street
Philadelphia, Pa., U. S. A.



BEAUDRY HAMMERS
For General Forging

Save Fuel, Time and Labor. Cut Forging Costs in Two.

Belt or Motor Driven

BEAUDRY & CO.
Incorporated
141 Milk St., Boston, Mass.

For Pointing, Tapering, or Otherwise Reducing Metal Rods and Tubes the

DAYTON SWAGING MACHINE

is more economical than rolling, grinding, milling, turning or drawing. It imparts strength and elasticity to the metal and gives a fine, smooth finish. All kinds of work—0 to 2 inches diameter.


NO. 3 MACHINE

The Torrington Company
Excelsior Plant
Successor to Excelsior Needle Co.
Torrington Conn.

Catalog tells the whole story

20-Ton Forcing Press and Roller Jaw Drill Chucks
Manufactured by
WEAVER MANUFACTURING CO.
SPRINGFIELD, ILLINOIS

CHAMBERSBURG STEAM HAMMERS
"All Sizes for Every Class of Work"
Our hammers are double acting, have simple valve gear and give the operator perfect control.
Write us for details.
CHAMBERSBURG ENGINEERING COMPANY, Chambersburg, Pa.
HYDRAULIC MACHINERY

LITTLE GIANT POWER HAMMERS

Powerful—
Versatile—
Durable—

Established
A. D. 1876



Little Giant Power Hammers are sturdy, powerful tools. They combine machine gun rapidity and precision with absolute rigidity.

They are made in five sizes—25- to 500-pound ram—each adapted for handling a great variety of work.

They are guaranteed *forever* against defective workmanship and materials.

Since the first Little Giant Power Hammer was built more than 25 years ago we have never heard of one going to the scrap heap. That is a pretty fair guarantee of lasting efficiency. There are more than 6000 Little Giant Power Hammers now in daily use.

Our repair sales for the last 25 years have averaged 48 cents per tool—less than two-fifths of one per cent of the original cost to purchaser.

Little Giant Power Hammers are safe, simple and compact. They occupy minimum floor space and are adapted for belt or motor drive.

Let us send details of our 30-day free trial offer. Write today.

Special dies for any forging purpose. Prices quoted upon receipt of drawings or sample of work to be done.

MAYER BROS. CO.
131 West Rock St.
MANKATO, MINN.
U. S. A.

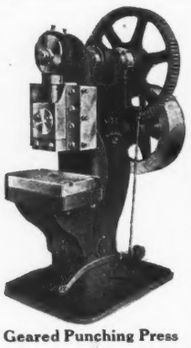
P.S.—Prompt Delivery

NIAGARA Power Presses

Niagara Power Presses are fast, accurate producers, perfectly balanced and easy to control. They will stand up under long, heavy usage in stamping, blanking, punching, drawing, trimming and drop forge work.



Inclinable Power Press.



Geared Punching Press

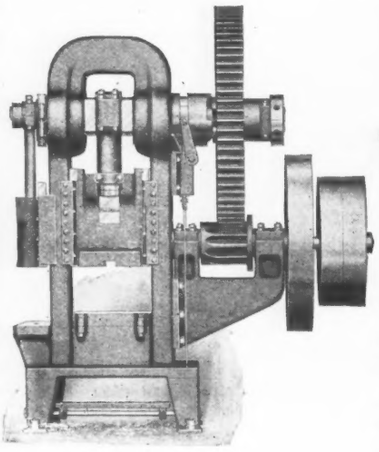
NIAGARA Power Presses occupy comparatively little floor space, and obtain maximum results on a given amount of power.

There's a size and style for every purpose.

Send for descriptive booklet.

NIAGARA MACHINE AND TOOL WORKS

BUFFALO, N. Y. U. S. A.



Straight Sided Trimming Presses

Full line of Trimming and Power Presses as well as Bull-dozers, Bolt and Forging Machines, Power Hammers, Punches and Shears, Gate Shears, Forging Rolls, Eye Benders—Multiple Punches, etc., included in our line.

Write for Catalog No. 10.

Williams, White & Co.

Moline, Ill. U.S.A.

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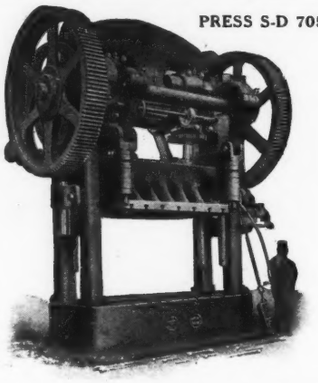
New York Office, C. H. Holbrook, 30 Church St.

Detroit Office, J. C. Austerberry, 924 Dime Bank Bldg.

FERRACUTE PRESSES

FOR CUTTING, FORMING AND DRAWING METAL

PRESS S-D 705



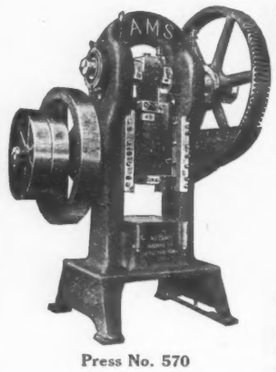
Double-action Toggle Drawing Presses, all widths, giving pressures of 100, 150, 200, 300, 400, 500, 700, 1000, 1500 and 2000 tons.

The press shown exerts 700 tons pressure and weighs 250,000 pounds. Ram stroke up to 18 inches and plunger stroke up to 36 inches. Distance between columns, 124 inches. Friction clutch. Unusually large safety factor.

Photographs and full information for the asking.

FERRACUTE MACHINE CO.

BRIDGETON NEW JERSEY



Press No. 570

PRESSES

LARGE OR SMALL
REGULAR OR SPECIAL

"AMS"

Let us quote you on your next press

THE MAX AMS MACHINE CO.

BRIDGEPORT CONN.

PRESSES—Foot and power.
WIRE FORMING MACHINES—Standard or special.
TUMBLERS—All kinds.
BALL BURNISHING EQUIPMENT.

BAIRD MACHINE CO.

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PRESSES and SHEARS

Sheet Metal Working Machinery

THE D. H. STOLL CO., Inc.

BUFFALO., N. Y.



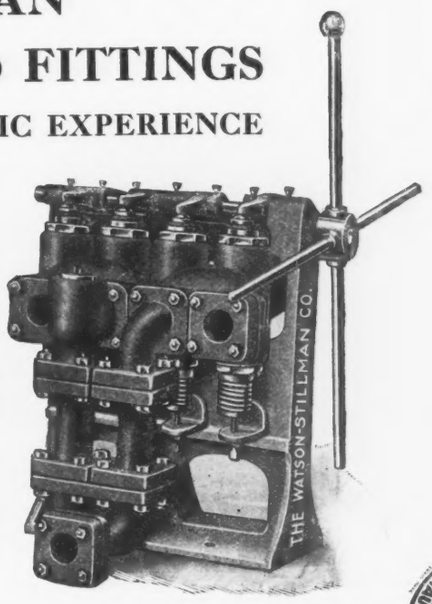



WATSON-STILLMAN
HYDRAULIC VALVES AND FITTINGS
ARE BACKED BY 70 YEARS HYDRAULIC EXPERIENCE



Our line embraces an almost endless number of combinations designed to meet the varied demands of hydraulic equipment. Each and every valve and fitting is tested far beyond its listed strength before shipping. These tests insure you against accident, loss of time and production.

We build hydraulic machinery for every purpose where hydraulic pressure is a possibility—presses, shears, benders, straighteners, punches, etc., as well as a full line of accumulators, pumps, intensifiers, etc.



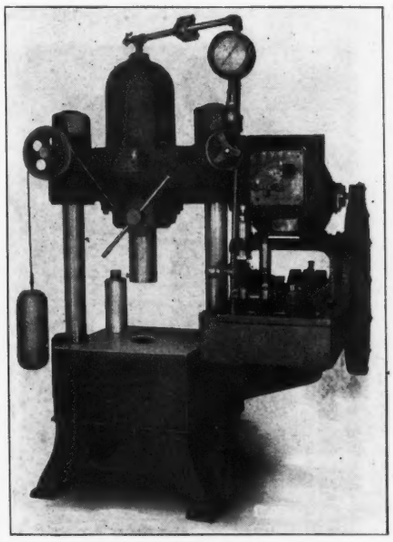
Write for Catalogs

The Watson-Stillman Co.
192 Fulton Street NEW YORK

CHICAGO: McCormick Building

417

HYDRAULIC
Machinery of Quality



Hydraulic Presses may be compared to watches. A watch is a watch — but what about the grade of materials and skill represented and the degree of satisfactory service rendered?

We build the "Waltham" grade.

THE HYDRAULIC PRESS MFG. CO.
Engineer-Builders of Hydraulic Machinery Exclusively
84 Lincoln Avenue Mount Gilead, Ohio

BRANCH OFFICES: Room 1105-R, 39-41 Cortlandt St., New York City; 427-D Guardian Bldg., Cleveland, Ohio.

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TEST PRESSES
For applying Internal Pressure Physical Test to Shells

BANDING PRESSES
For Pressing in Copper Rotating Bands on Shells

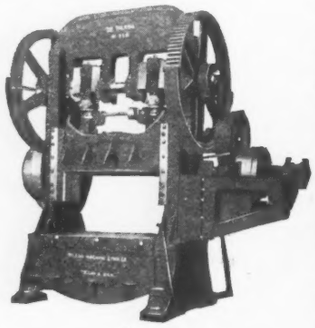
METALWOOD MANUFACTURING CO.
DETROIT, MICHIGAN

SALES REPRESENTATIVES

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THE "TOLEDO" PRESSES

Overcome, by their efficiency, the shortage of labor problem caused by our country's need for men.



These strong, durable, dependable double crank presses, with many advanced ideas and exclusive features, are adaptable for almost any sheet metal or drop forged work. They are built in over 250 sizes and styles ranging in weight from 4500 to over 400,000 lbs. There is no press or die requirement which we are not fitted by experience, knowledge and skill to fill ably, economically, promptly.

The Toledo Machine & Tool Co.
Toledo, Ohio

OVER-SEAS REPRESENTATIVE
ALMACOA ALLIED MACHINERY COMPANY OF AMERICA ALMACOA
120 BROADWAY, NEW YORK, U.S.A.

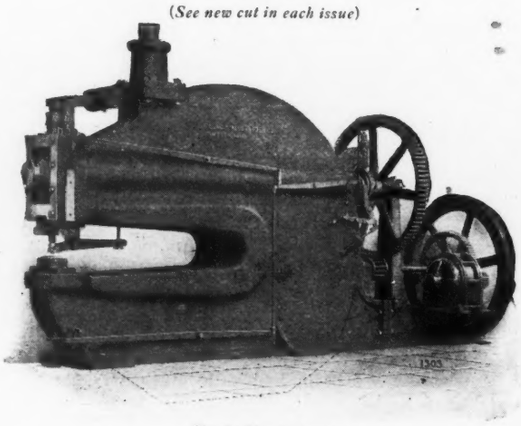
PARIS TURIN ZURICH BARCELONA

Established 1856 Incorporated 1878

The Quality Line

Punching, Shearing and Forging Machines and Machinery Equipment for Shipyards, Steel Car Plants, Rolling Mills, Bridge and Structural Iron Works

(See new cut in each issue)

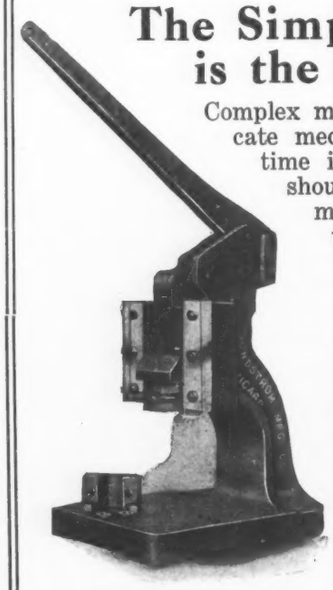


Single No. 1 Punch

All machines are built of the same high grade workmanship and material that has given The Long & Allstatter product a recognized standard of quality for over 50 years.

The Long & Allstatter Co.
Hamilton, Ohio, U. S. A.

The Simplest Way is the Best Way



Complex machines with intricate mechanism mean lost time in the shop which should be working every minute—and working to capacity. The Rex Testing Press needs no adjustment, is sensitive to accurate alignment; a one-man tool that saves space, time and energy. It tests dies, finds blanks, scrapes and stamps without injury to the work and is safe and easy to handle.

The Rex Die Testing Press

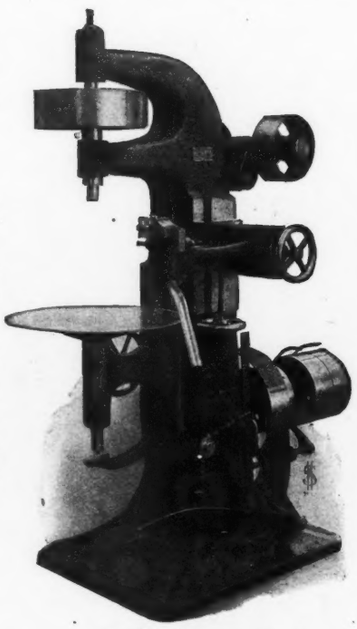
will pay for itself in a very short time. It will more than back up our claims for it.

Details on request

SUNDSTROM MFG. CO.
3201 SHIELDS AVENUE CHICAGO, ILL.

SWAINE

DOUBLE SEAMER No. 4

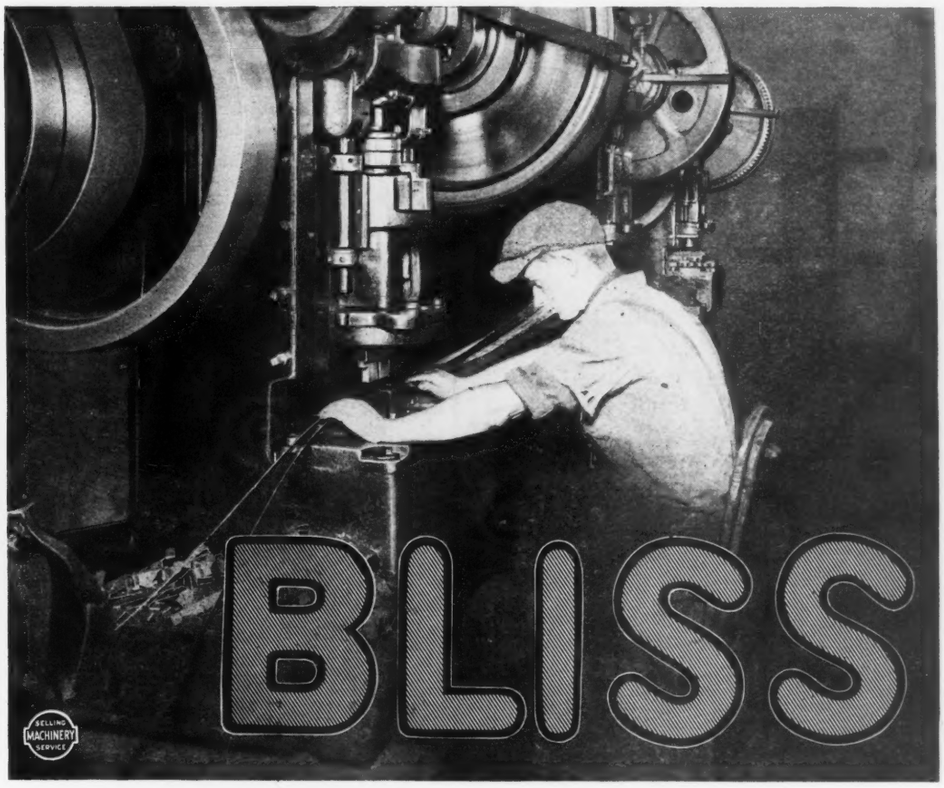


The precise alignment of the upper and lower spindle and the ease with which it is adjusted for work of different sizes are features which enable this machine to do the high class of work for which it is known.

Write us for catalog giving complete details.

Double Seamer No. 4

FRED J. SWAINE MFG. CO.
7th and O'Fallon Sts. ST. LOUIS, MO.
Largest Press Builders in the West



A Bliss Press Blanking and Forming 1000 Parts per Hour

BLISS 1857-1918 BLISS

E. W. BLISS CO.

Main Office & Works:
BROOKLYN NEW YORK

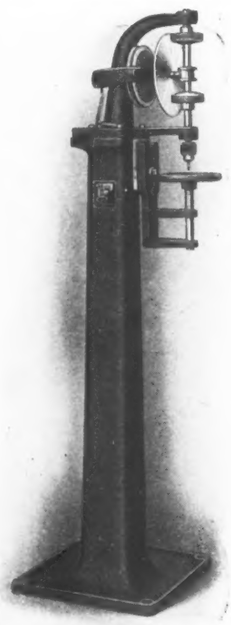
CHICAGO OFFICE People's Gas Bldg. DETROIT OFFICE Dime Bank Bldg. CLEVELAND OFFICE Union Bank Bldg.

LONDON, S.E., ENGLAND, Pocock Street, Blackfriars Road
PARIS, FRANCE 100 Boulevard Victor Hugo St. Ouen

ONE thousand parts per hour is this machine's record for blanking and forming lock strike rims from .072″ stock. The Russell & Erwin Company, of New Britain, Conn., has used Bliss machines for 28 years, now has nine, and may be considered mighty sound authority on the kind of service they render (we happen to know the opinion is favorable.)

The operation illustrated is performed on one of four Bliss Double Acting Presses in this department. Two Bliss Inclinables and three other Bliss Presses are also used.

Bliss Power Presses for every purpose.



THE FENN TAPPER

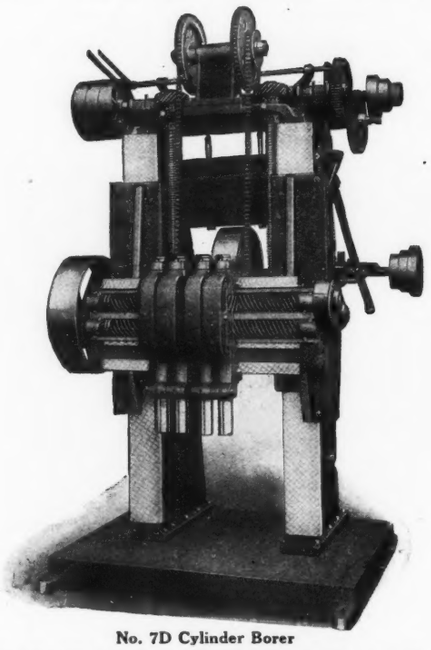
A mighty "big" little machine, with interesting special features.

It is rigid, well built, and practically free from vibration; it has friction drive and reverse, with control so sensitive as to eliminate broken taps even at top speed.

Especially suited to Fuse, Electrical and Gun Work. Circular.

FENN MANUFACTURING CO.
Hartford W. L. FENN & W. A. FENN **Conn., U.S.A.**
Cable Address: "Fenn"—Western Union Code

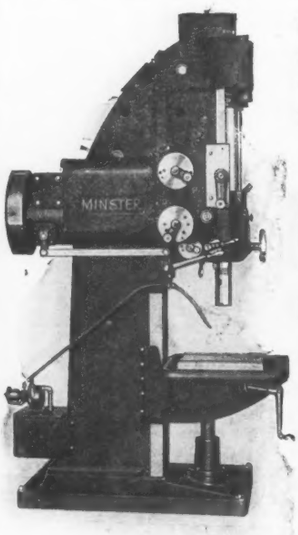
THE "HOLE HOG" LINE



No. 7D Cylinder Borer
Built for Rapid and Correct Production on Tractor, Truck and Aeroplane Motors.
Catalog Describes Others

MOLINE TOOL CO., Moline, Ill.
Multiple Drillers, Borers and Thread Hobbers.

Hi-Duty DRILLS



Special spindle construction and great variety of speeds and feeds make

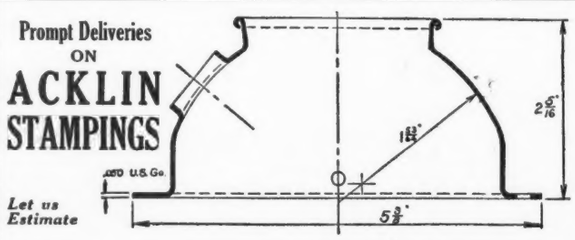
THE
MINSTER
DRILL PRESS

practically indispensable for a wide range of heavy drilling. Particularly well adapted for enlarging holes in steel and cast iron. Specifications call for durable quality in all working parts and correct balance insures smooth running.

Rigid, powerful, responsive, this machine will give you full service.
1-D—2" 2-D—2½" 3-D—3¼"

THE MINSTER MACHINE CO.
MINSTER OHIO, U. S. A.

Prompt Deliveries ON
ACKLIN STAMPINGS



Let us Estimate

Many parts, such as this half casing for an automobile universal joint, are much more satisfactory stamped than cast—cheaper, stronger, far more durable and require no machining. *Let us talk it over.*

THE ACKLIN STAMPING CO.
1657 Dorr Street TOLEDO, OHIO, U. S A.

BUCHER BETTER SMITH SERVICE KEYSEATER



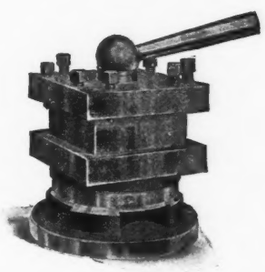
Compact, convenient, inexpensive, it operates accurately at low cost. Designed to cut keyways ¼" to 1¼" wide, 12" long in shafts 1¼" to 5" in diameter without resetting. A portable, rigid and speedy machine.

Circular gives details.

The Bucher-Smith Company
Engineers and Machinists
East Liverpool, Ohio







Make a Better Tool of Your Engine Lathe

With Phoenix Turret Attachments you can get maximum service from your engine lathes, save time for your turret lathes. Certain jobs cannot be handled profitably on either the engine or the turret lathe. Phoenix Turret Attachments are the solution. They will complete many jobs in the time it formerly took to set them up.

Will you not investigate further?

PHOENIX MANUFACTURING CO.

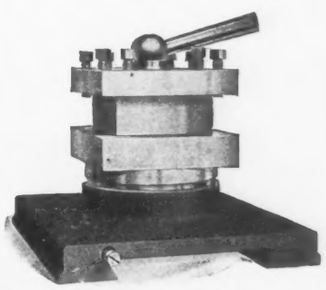
EAU CLAIRE WISCONSIN

Cleveland Office: 913-15 Engineers Bldg.

THERE are now more than 3000 Phoenix Turret Attachments in use on all kinds of engine lathes.

PHOENIX TURRET ATTACHMENTS

are strong, durable and easy to attach. They have improved locking devices to insure rigidity while in use and are quickly released by a three-quarter turn. Many styles and sizes meet all requirements.



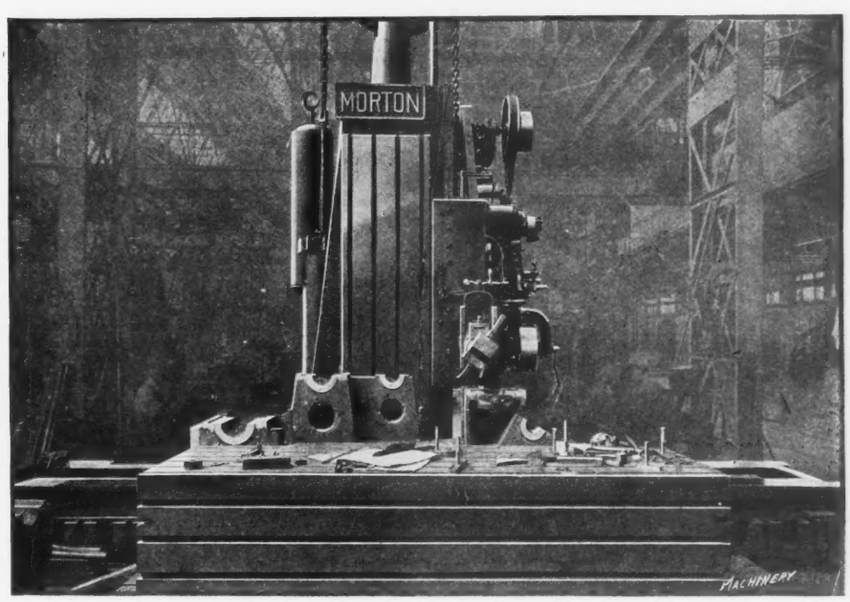
MORTON Draw Cut Planers

Bulletin No. 8-D for full description.

MORTON MFG. COMPANY

Muskegon Heights

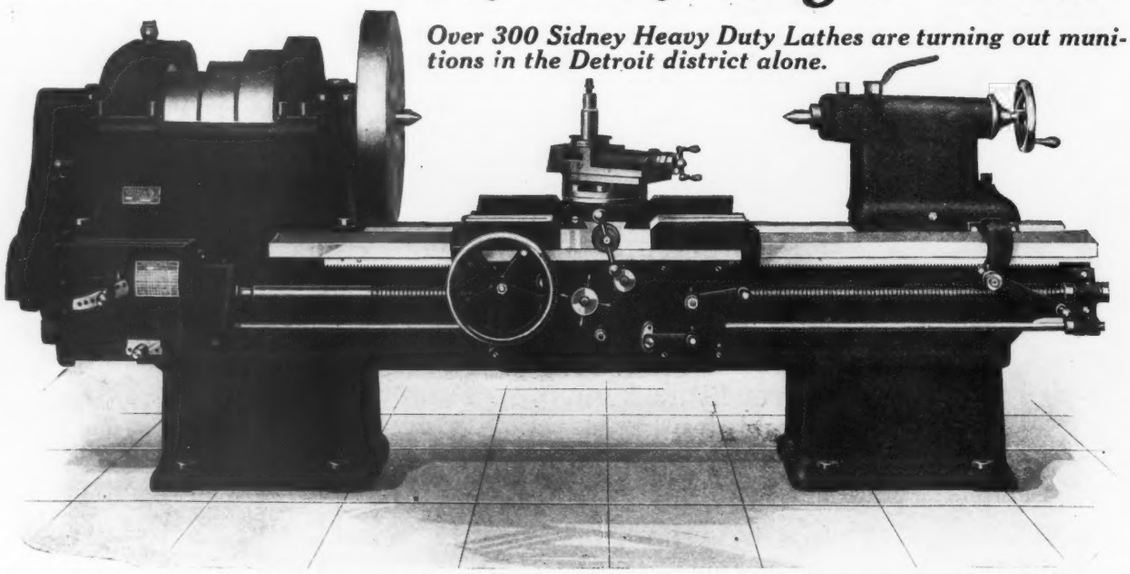
MICHIGAN



POWERFUL, flexible, economical, the Morton Draw-Cut Traveling Head Planer, with Drilling and Boring Equipment, handles work accurately at all angles and can perform a number of operations at a single setting. Simply designed, easy to operate, it runs smoothly and with almost no vibration. The "Morton" occupies only half the floor space of a housed planer and takes only one-fourth the power. Capacity up to 100 tons. Let us tell you what it has done for others in the saving of time and money.

SIDNEY Heavy Duty Engine Lathes

Over 300 Sidney Heavy Duty Lathes are turning out munitions in the Detroit district alone.

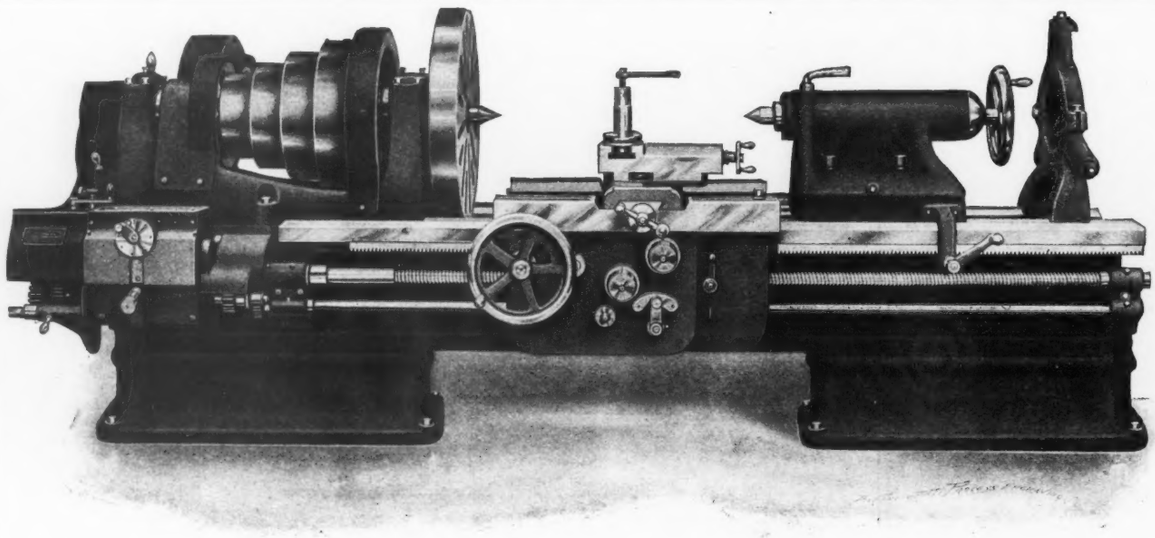


From the Sidney line of 15", 17", 19", 25" and 27" swings, built on beds from 6 feet to 20 feet, and fitted with any extra attachments required, you can equip a complete lathe department to your shop, whether it is for Government munition work or any other line of high production manufacture.

New Bulletins just issued on 25-Inch Machine. Write today!

THE SIDNEY TOOL CO., Sidney, Ohio, U. S. A.

AGENTS: Lynd-Farquhar Co., Boston, Mass.; J. J. McCabe Lathe & Machinery Corpn., New York City; Frank Toomey, Inc., Philadelphia, Pa.; Smith-Courtney Co., Richmond, Va.; McCoy-Brandt Machinery Co., Pittsburgh, Pa.; Simmons Machine Co., Inc., Albany, N. Y.; H. A. Smith Machinery Co., Syracuse, N. Y.; Homer Strong, Inc., Rochester, N. Y.; Strong, Carlisle & Hammond Co., Cleveland, Ohio; Vonnegut Machinery Co., Indianapolis, Ind.; The Chas. A. Strelinger Co., Detroit, Mich.; Wayne Machinery Co., Ft. Wayne, Ind.; Marshall & Huschart Mchy. Co., Chicago, Ill.; Bowman-Blackman Machine Tool Co., St. Louis; Young & Vann Supply Co., Birmingham, Ala.; Oliver H. Van Horn Co., Ltd., New Orleans, La.; Herberts Machinery & Supply Co., Los Angeles, Cal.; Fred Ward & Son San Francisco, Cal.; Hendrie & Bolthoff Mfg. & Supply Co., Denver, Colo.; The Salt Lake Hardware Co., Salt Lake City, Utah; The Portland Machinery Co., Portland, Ore.; Perine Machinery Co., Seattle, Wash.; F. E. Satterlee Co., Minneapolis, Minn.; H. W. Petrie, Ltd., Toronto, Canada; Geo. F. Foss Machinery & Supply Co., Montreal, Canada.



30-Inch Instantaneous Change Gear Engine Lathe

Double Back Geared Double Plate Apron

THE BOYE & EMMES MACHINE TOOL CO.

2245 to 2251 Spring Grove Avenue CINCINNATI, OHIO, U. S. A.

"WHITNEY"
HAND MILLING MACHINE

THOUSANDS IN USE

Note that the

"WHITNEY"

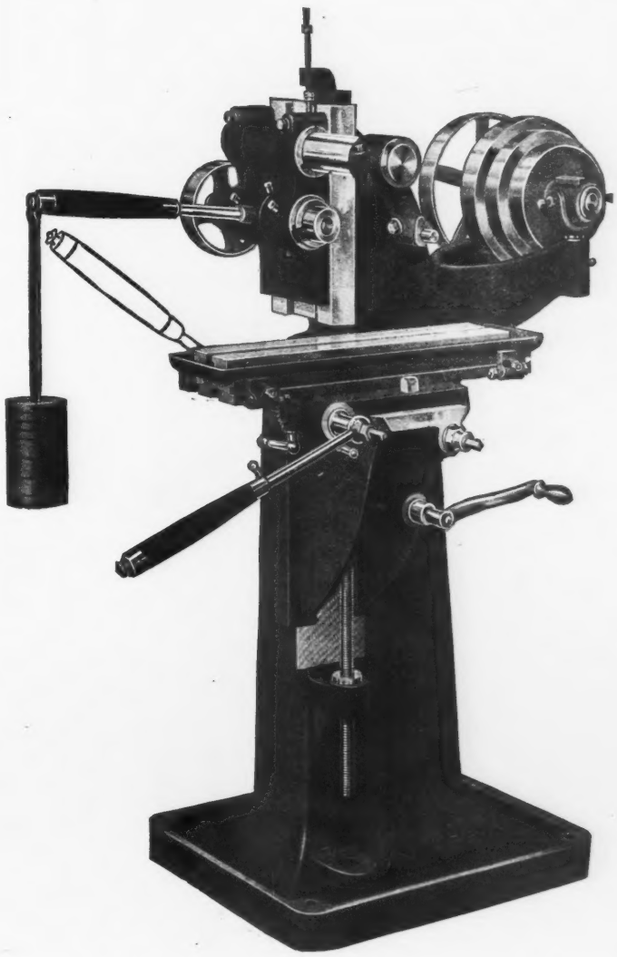
is different from the usual type of Hand Milling Machine.

The

Sliding Head

is its distinctive feature, thus giving advantages possessed by no other type of Hand Miller.

The spindle is driven by interchangeable side pulleys, giving six spindle speeds with three grade cone and four with two grade cone.



PROMPT DELIVERIES

THE WHITNEY MFG. COMPANY
HARTFORD, CONNECTICUT

CHAINS KEYS AND CUTTERS HAND MILLING MACHINES

"I'm Spending Too Much For Heat Treatment"

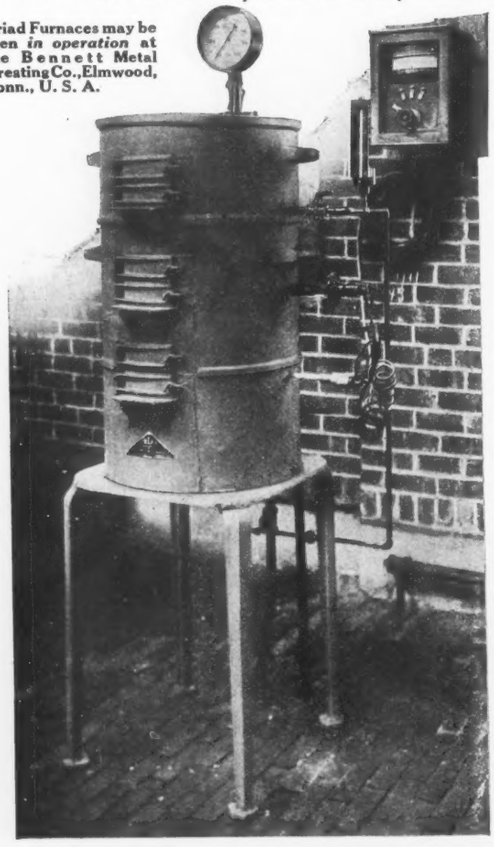
That's what everyone who sees the Triad Combination Furnace in operation says. Considering the saving the "Triad" effects in first cost, fuel, space, labor and installation, they have good cause to remark. It performs hardening, preheating and tempering operations at little more than the cost of any one of these.

The three processes may be carried on simultaneously. Proximity of chambers to each other eliminates danger of oxidation in products. Waste heat from high-speed chamber on bottom supplies other units.

You also may see Triad Furnaces in operation. Meantime send for the circular

W. R. BENNETT, Elmwood, Conn.

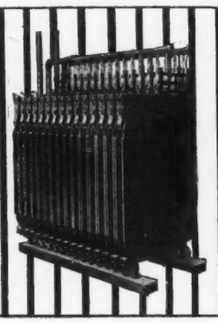
Triad Furnaces may be seen *in operation* at the Bennett Metal Treating Co., Elmwood, Conn., U. S. A.



TRIAD

Combination Furnaces





SOME day—when failure to receive your supply of cylinder gas has interrupted your work and cost you heavy losses—you'll investigate the advantages of an I. O. C. Gas Generating Plant of your own.

But why wait for trouble? Why not prepare against it, now?

Send for Bulletin 20, about "The Cell with Three Times the Capacity Per Unit of Space"

INTERNATIONAL OXYGEN COMPANY
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Standardized Apparatus

FUEL OIL

We respectfully solicit your inquiries.

AMERICAN PETROLEUM PRODUCTS CO.
CLEVELAND OHIO, U. S. A.

Address Dept. P



This book tells of the up-to-date Methods of Case-Hardening. Copy sent free on request.

KASENIT

Non-Poisonous

Open-Fire Hardening Compound

Rapid and uniform surface hardening without poisonous smoke and fumes. Replaces dangerous materials heretofore used. *Ask your dealer or write us.*

"KASENIT No. 4"

Is the Perfect Carbonizer for oven work. Absolutely uniform and dependable results at low cost.

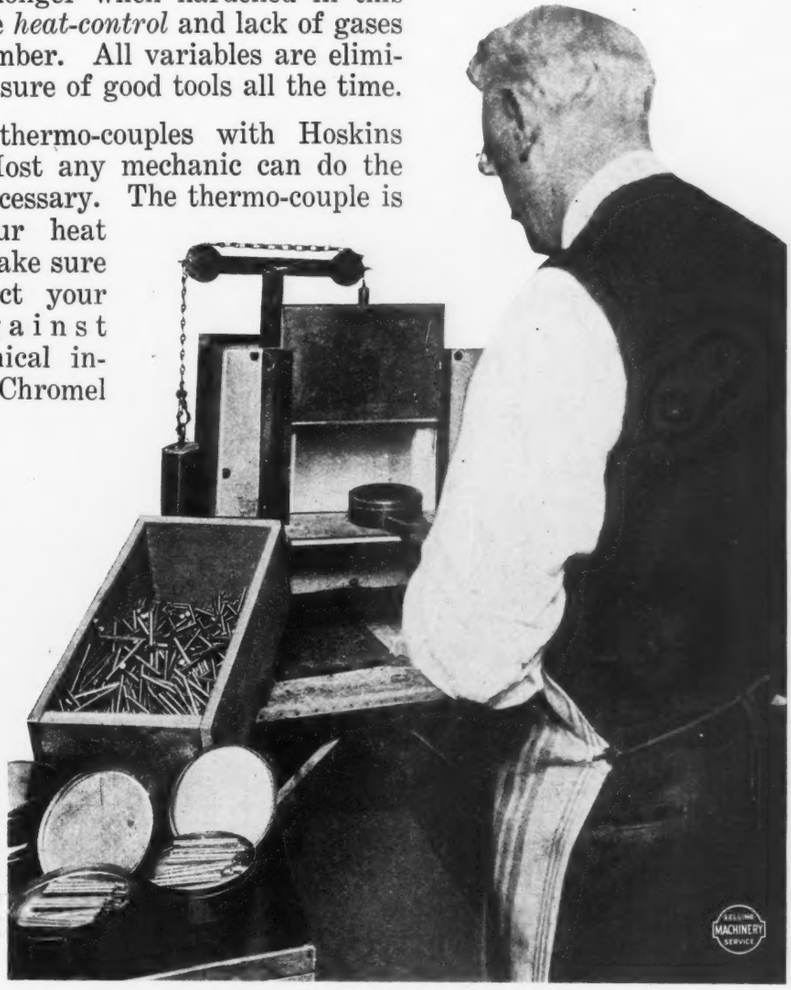
KASENIT COMPANY
11 Water Street New York

HOSKINS
ELECTRIC FURNACES

Annealing 240 Parts at a Time with Absolute Uniformity

In the making of high grade fishing reels, the Horton Manufacturing Company of Bristol, Conn., considers the matter of heat treatment a most important factor—so much so, that two years ago it brought this Hoskins Furnace all the way up from Kentucky to install in its Bristol plant. The photographed operation is annealing fishing-reel pinions. The furnace accommodates six boxes, each box containing 40 pinions. The 240 parts are annealed quickly, economically and *with absolute uniformity throughout.* Heat control does it. These furnaces are made in larger sizes for the heat-treatment of tools. Tools last longer when hardened in this way, because of the *heat-control* and lack of gases in the heating-chamber. All variables are eliminated and you are sure of good tools all the time.

Make your own thermo-couples with Hoskins Chromel Wire. Most any mechanic can do the job. No skill is necessary. The thermo-couple is the heart of your heat treating outfit. Make sure it's right. Protect your thermo-couples against gases and mechanical injury with Hoskins Chromel Protection Tubes.



Send for Bulletins No. 10 and No. 3

HOSKINS MFG. CO.
459 Lawton Avenue
Detroit, Mich.

Grand Central Terminal
New York City
Canadian Hoskins, Ltd.
Walkerville, Ont.
Otis Building, Chicago
Tremont Bldg., Boston
Oliver Bldg., Pittsburgh

COLTON-DETROIT



All Forged High Speed Drills

With Colton-Detroit All Forged High Speed Drills a greater number of holes are obtainable than with the average. They can be rotated faster — they last longer. Forging gives them a backbone which *insures* maximum service under all conditions.

And a Word About Grinding

The original grinding of Colton-Detroit All Forged High Speed Drills is guaranteed accurate. By keeping them correctly ground the best results are assured.

We will instruct at our plant mechanics employed by large users of drills in the correct method of grinding. *Your* men are invited.

USE COLTON-DETROIT DRILLS AND SAVE ON YOUR TOOL BILLS

Catalog of the complete line will be mailed upon request

ARTHUR COLTON CO.
785 Jefferson Avenue
DETROIT MICHIGAN, U. S. A.

STOP WASTED TIME



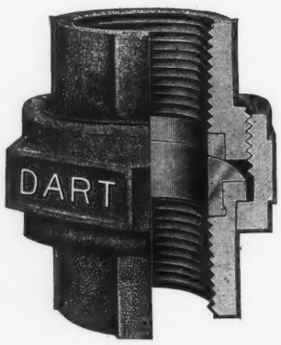
Make Your Machines Produce Every Minute of the Working Day.

One set of nine "Nicholsons" affords an instant fit for any size hole—round or square—from one to seven inches. Quick to insert; quick to remove.

NICHOLSON EXPANDING MANDRELS

Give you full value from your machinists' time. Increased production simply has to follow, with greater accuracy. "Nicholson" cannot distort—the jaws are always concentric. Put a Nicholson to the test in your factory. We will gladly loan you one for 30 days' trial. Send for our Mandrel booklet. It tells how and why "Nicholsons" stop wasted time.

W. H. NICHOLSON & CO.
112 Oregon St. WILKES BARRE, PA.



SPECIFY "DART" and your unions will out-last the rest of the pipe—two bronze seats prevent rust or corrosion — malleable iron pipe ends and nut insure strength.

Ask us about them or send for Sample Union.

E. M. DART MFG. CO. PROVIDENCE Rhode Island
The Fairbanks Co., Sales Agents. Canadian Factory: Dart Union Co., Ltd., Toronto

Is Good Tool Steel High and Hard to Get?

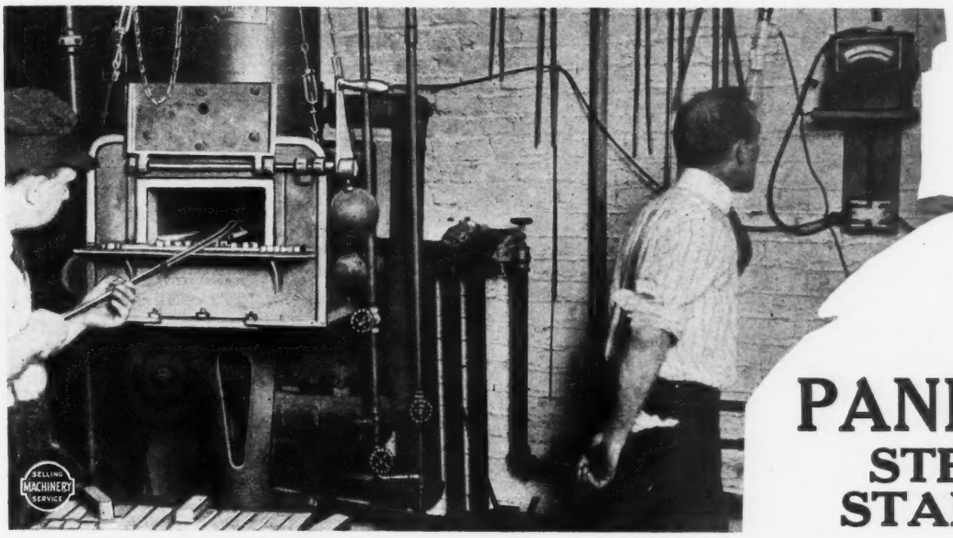
Then conserve the steel you have; don't scrap your worn out tools; send them to us, see what a high speed steel expert can do to reclaim them.

THE J. C. GLENZER CO., 3 14th St., cor. Fort, Detroit, Mich.

TAPS AND REAMERS

First-class Tools and Prompt Deliveries

REIFF & NESTOR CO., Lykens, Pa.



Three factors safeguard the temper of Pannier Steel Stamps:— a good furnace, an accurate pyrometer and an experienced specialist on steel stamp treatment.

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How We Make It Easy For Our Salesmen

Sales "patter" frequently gives an inferior product a temporary hold on the market; a good article, once known, sells itself permanently. The age of our establishment proves we have been mindful of these facts. Pannier Steel Stamps are made of the best obtainable material, in a thoroughly modern plant, by genuine "old-timers" in this industry, to whom steel stamps represent more than mere intrinsic value. They make it easy for the Pannier salesman. He doesn't have to argue. He knows he can safely say—"Try them."

PANNIER BROTHERS STAMP COMPANY, Inc., Pittsburgh, Pa., U.S.A.

"Saws" All Over the World



In every line of work DISSTON SAWS for wood and metal, tools and tiles, play a large and important part.

HENRY DISSTON & SONS, INC.

KEYSTONE SAW, TOOL STEEL AND FILE WORKS

PHILADELPHIA, U. S. A.

How do *you* handle *your* castings and forgings?



ONE at a time? Paying men to pick them up off the floor and load them on to trucks—moving them to the proper place—piling them off one at a time on the floor—then picking them up one at a time and loading them on to a truck again—and then on to the next operation—and so on?

If so you have a real opportunity to save a big item of expense—no matter how small your shop or how large. By installing the Barrett System you can eliminate four-fifths of the handling in your shop—and when you stop to figure it, one of the most costly items on your books is that of handling materials—getting things moved from one place to another. It's an expense that goes on every hour of the day—day in, day out—increasing your costs, eating into your profits.

What's more, the Barrett System can be started in your shop without upsetting your present methods in any way. No inconvenience of any kind—no cost unless you **actually save enough money** to cover your investment many times over in a very short time.

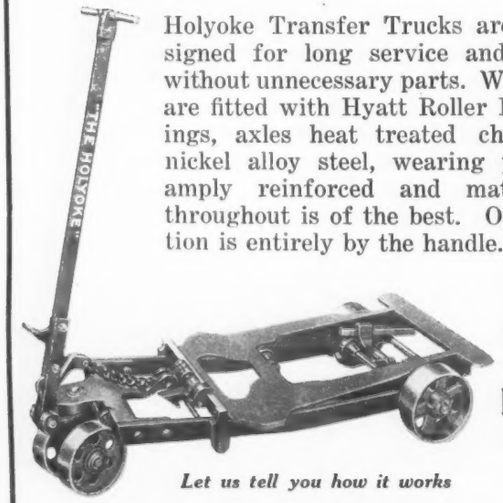
Write *at once* for free illustrated booklet showing exactly how you can put the Barrett System to work in your shop, immediately, *without cost and without obligation.*

BARRETT-CRAVENS COMPANY
713 Transportation Building, Chicago, Ill.

BARRETT MULTI-TRUCKS

THE HOLYOKE TRUCK

DETAILED INFORMATION ABOUT OUR PRODUCTS ON FILE AT ALL THE NATIONAL RED BOOK SERVICE STATIONS — ONE IS LOCATED NEAR YOUR OFFICE



Holyoke Transfer Trucks are designed for long service and are without unnecessary parts. Wheels are fitted with Hyatt Roller Bearings, axles heat treated chrome nickel alloy steel, wearing parts amply reinforced and material throughout is of the best. Operation is entirely by the handle.

Few Parts

Built to Last

Let us tell you how it works

HOLYOKE TRUCK CO.
112 RACE STREET HOLYOKE, MASS.

Distributors for Metropolitan District
YOUNG, CORLEY & DOLAN, Inc.
115 Broadway NEW YORK CITY

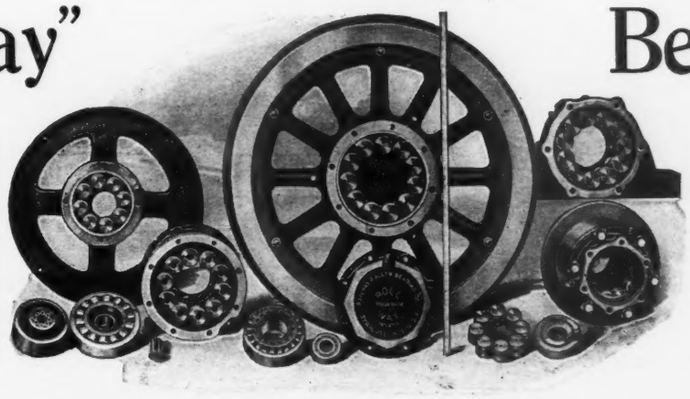
HIGH ON SPEED
Trade Mark

Let us Convert your High Speed Steel Scrap into Bars—Every Bar Guaranteed

ONONDAGA STEEL COMPANY INC.
SYRACUSE, N.Y.

"Rollway" Bearings

A Three Year Guarantee With Every Installation



All Rollers Midvale No. 6 Races 3½% Nickel Steel

No load too heavy, no conditions too severe for "Rollway" Bearings. We back this statement with any amount of proof—actual cases where, after operating continuously for years under most severe and exacting conditions, in places where other bearings had been destroyed in as many months, "Rollways" showed no signs of wear.

ROLLER BEARINGS for RAILWAY and INDUSTRIAL PURPOSES

Beside being durable, "Rollways" save—80 per cent in lubrication, 4 per cent in power and all cost of rebabbitting. They require only infrequent inspection and are made to your design or designed to meet your requirements.

"Rollway" Bearings installed in old motors give them a new lease of life.

May we send you *Descriptive Literature?*

ROLL TRADE MARK WAY

Railway Roller Bearing Company
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You Can "Eat Your Cake and Have It Too" With
CHAPMAN TYPE BEARINGS





THEY WILL FIT YOUR PRESENT HANGER FRAME

Chapman Bearings on Shafting Hangers, Pillow Blocks, Loose Pulleys and Friction Clutches, soon save enough power to pay for themselves and begin bearing interest. Ordinary bearings and self-oiling bushings waste enough to pay for this profitable equipment over and over again—without getting the benefit. We install Chapman Type Bearings to meet any transmission requirements, guarantee them to save 95 per cent on lubricant and attention and at least 15 to 20 per cent on power. Sixteen years on the market, Chapman Bearings are standard equipment in three or four thousand factories—some of the largest in Canada and U. S.—and reports on many of the first installations show them still doing full duty with no visible signs of depreciation.

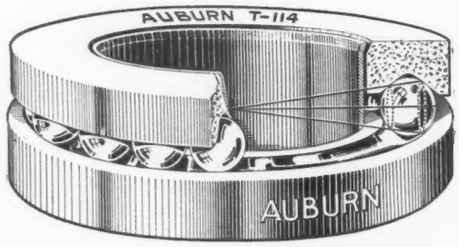
Read what users say in "Results." Read what we claim in Catalog 3B. Both mailed promptly on request.

TRANSMISSION BALL BEARING COMPANY, Inc.

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CHAPMAN DOUBLE BALL BEARING CO., Ltd., 339-351 Sorauren Avenue, Toronto, Ont.

END THRUST FRICTION TROUBLE OVERCOME

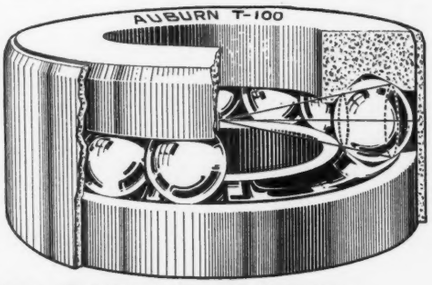


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State your difficulties, or ask for bulletins.

Steel, Brass and Bronze Balls



AUBURN BALL THRUST BEARINGS

AUBURN BALL BEARING COMPANY, 33 ELIZABETH STREET, ROCHESTER, N. Y.

Ball Thrust Bearings made to meet your requirements

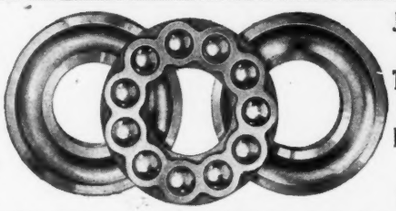
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FOR HIGH SPEED — FOR HEAVY DUTY

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MACHINISTS MILLWRIGHTS

POWER TRANSMISSION MACHINERY
GEARS
FOR MOTOR, MACHINE, MILL OR POWER PLANT
ROPE DRIVES A SPECIALTY



FRICTION CLUTCH PULLEY

We lay out, make drawings, furnish the material and erect it. Special machinery built to drawings and specifications.

WORKS: ELIZABETHPORT, N. J.

Factory resources and service go hand in hand with

STANDARD ROLLER BEARING PRODUCTS

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ANNULAR BALL BEARINGS

(Single and double row)

Standford SRB

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STANDARD ALLOY STEEL BALLS

SRB

Improved Type

TAPER ROLLER BEARINGS

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"NORMA" PRECISION BALL BEARINGS

(PATENTED)

Today, the measure of value is the capacity for service—in machines as in men. Not "what is the price," but "what will it do," is the decisive question. To be saleable today, a machine must above all else be serviceable—it must be capable of bearing its share of the national over-load. And serviceability commands a ready market and a good price.

"NORMA" Precision Bearings are the standard bearings in hundreds of thousands of high-speed machines—simply and solely because the test of time has proved their preeminent service capacity. Their maximum-service qualities are recognized by machine builders who place performance above price.

BE SAFE. See That Your Machines Are "NORMA" Equipped.

THE NORMA COMPANY OF AMERICA

1790 BROADWAY NEW YORK

Ball, Roller, Thrust and Combination Bearings





No toggle joints, meaningless parts, or complicated attachments

Hilliard Clutches and Government Shops

Government shops can depend not only on the performance of Hilliard Clutches, but also on deliveries.

We promise to give priority at all times to plants doing government work.

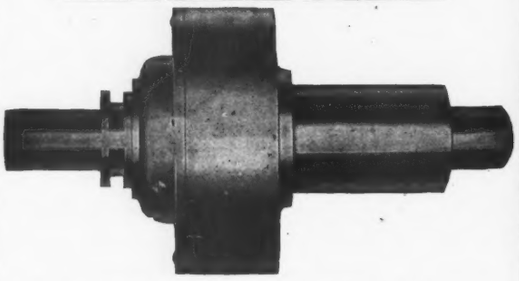
Practically any machine can be individually controlled through Hilliard Clutches.

Chapman Ball Bearing or Hyatt Roller Bearing Sleeves supplied for high speed work, and are recommended.

Ask for further details.

THE HILLIARD CLUTCH & MACHINERY CO.
ELMIRA **NEW YORK, U. S. A.**

CLEVELAND
The Dependable CLUTCH



SIMPLE-DEPENDABLE-ADAPTABLE

Engages gradually—releases instantly. No parts to burn out, work loose or damage—no exposed parts. Easily adjusted to a given load and may be modified to meet special requirements.

All parts are interchangeable—single oiling lasts months.

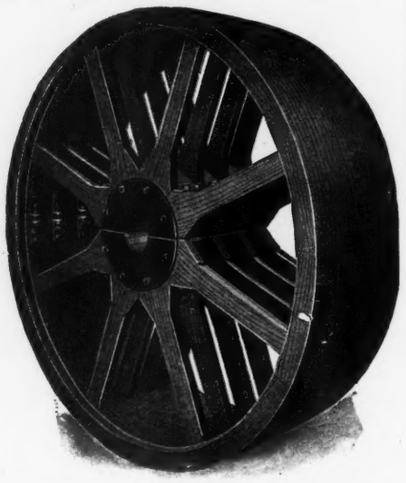
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THE RELIANCE GAUGE COLUMN CO.
6008 Carnegie Avenue **CLEVELAND, OHIO**

Gilbert Wood Split Pulleys

Style "A"

For Safety Speed and Service



GILBERT WOOD PULLEYS are carefully made of seasoned wood, and can be safely run at very high speeds. The hard wood surface transmits more power than a steel pulley, weight is only half as much, cost is less, and wear is guaranteed. Various styles and sizes.

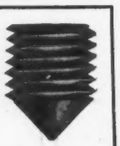
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SAGINAW MFG. COMPANY
SAGINAW, W. S., MICHIGAN
Sales Agencies in All the Principal Cities in the World
N. Y. Branch, 88 Warren St. Chicago Branch, 105-109 So. Jefferson St.
Cable Address, Engrave. A. B. C. and Lieber's Codes



Cap Screw

ALLEN SAFETY (HOLLOW) SET SCREWS



U. S. Patent, June 7, 1910 Set Screw

Safe, strong, convenient and durable, Allen Safety Set Screws are manufactured by a special process which increases their strength 30 per cent. They're guaranteed. Carried in stock in U. S. Standard and V Threads—¼ to 1½ inch diameters. *Catalog and Samples Free.*

CLEAN SOCKET HOLES · 30% STRONGER · THE ALLEN · UNIFORM THREADS · ABSOLUTE SAFETY

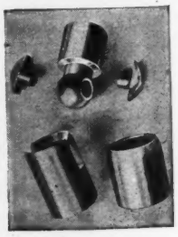
THE ALLEN MFG. CO.
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HARTFORD, CONN., U. S. A.

COOPER
PATENTED UNIVERSAL JOINTS
For Universal Uses



Shaft Sizes ⅛" to 2"
Double or Single
Carbonized
Hardened and Ground
Ample Oil Receptacle
Smooth Exterior
Five Parts—No Screws
Compact

Carbonizing and Screw Machine Products



COOPER FLEXIBLE TRANSMISSION CO., Inc.
8th Ave. and 18th Street **BROOKLYN, N. Y.**

4 MONTHS OR 5½ YEARS

Did you ever have a metal bearing last more than four months at the most on a loose pulley or friction clutch? Here's an Arguto Oilless Bearing that showed no signs of wear after 5½ years "on the job."

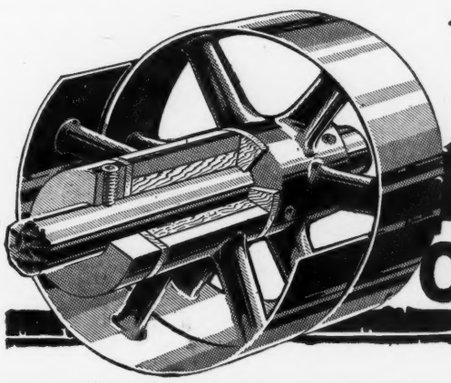
Consider the saving the user made on this bearing alone:

Cost of metal bearing - - - - -	$9.73	Arguto $2.86
Metal bearings used yearly - - - -	3	
Metal bearings cost yearly - - - -	$29.19	
	5½ yrs.	
	$160.55	$2.86

One Arguto saved $157.69

With the entire plant equipped with Arguto Oilless Bearings, the saving in first cost alone is a big item. Add to it, oilers' services that can be dispensed with, and the saving to belting and product, through the elimination of dripping oil, and you can readily see why so many manufacturers specify Arguto for their bearings. Try two or three on some of your troublesome bearings, and check up the figures for yourself. *Full particulars on request.*

ARGUTO OILLESS BEARING COMPANY
145 Berkley Street Wayne Junction
PHILADELPHIA, PA.



ARGUTO
Oilless Bearings
Arguto NON-METALLIC

Ball and Roller Bearings

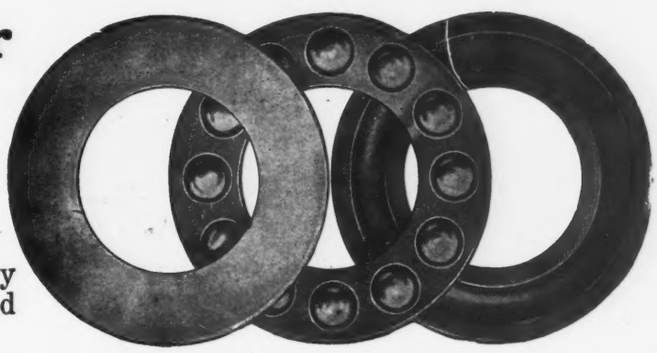
Quality Bearings for Every Bearing Need

Our line is complete and of uniformly high quality, design, material and workmanship.

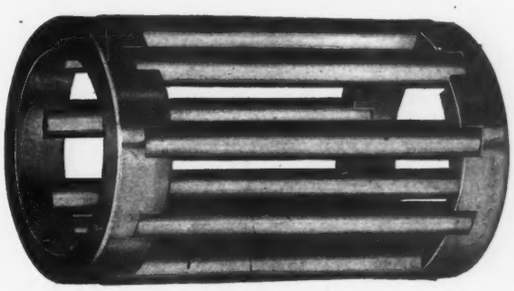
We manufacture: Radial Roller Bearings, Journal Roller Bearings, Roller Thrust Bearings, Ball End Thrust Bearings (in both inch and millimeter sizes), Cylindrical Rollers.

We have unusual facilities for the manufacture of cylindrical rollers.

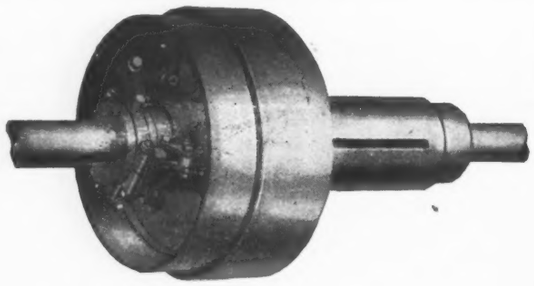
We specialize in anti-friction service. Can we help you?



New Catalog No. 9 gives all the details



THE BALL & ROLLER BEARING COMPANY
Danbury Connecticut, U. S. A.



Longer Life
Less Upkeep Expense
Greater Durability
Better Satisfaction

FOUR STERLING QUALITIES POSSESSED BY

MOORE & WHITE FRICTION CLUTCHES

Their wearing qualities are guaranteed by the first-class workmanship and materials that enter into the construction of all Moore & White Friction Clutches that leave our plant. The upkeep is reduced to a minimum by the small number of repair parts needed, and unless the Clutches are subjected to some extraordinarily terrific strain or sudden jerk they will run a long time without needing repairs.

Moore & White Friction Clutches are extremely simple in design and require but little adjustment. Not at all necessary to be an expert mechanician to understand their make-up.

Cannot throw oil or become accidentally engaged. Will transmit the full power at all times. Allow instantaneous stopping of one or all machines.

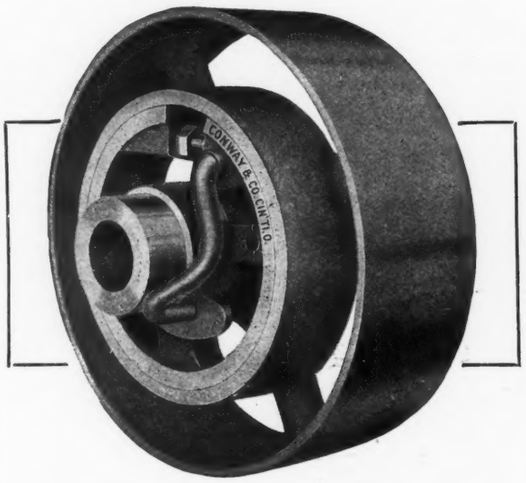
In fact, Moore & White Friction Clutches will give you the service, in the best manner possible, that Friction Clutches were designed for. They're made to last a lifetime and satisfy the user.

Booklet "M" FREE Upon Request.
A complete treatise upon Friction Clutches.
No mill owner, superintendent, buyer or man in the shop should be without it.
Send for it today. Yours for the asking.

THE MOORE & WHITE CO.
2707 to 2737 N. 15th St. PHILADELPHIA, U. S. A.

SOLD BY ALL GOOD DEALERS

The C-M-T



For Countershafts

CONWAY & COMPANY
Fairmount Cincinnati

Manufacturers of Friction Clutches since 1895



CRESSON-MORRIS CO.

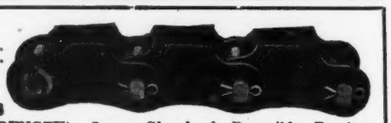
Power Transmitting Machinery

We make a specialty of equipping plants completely with Power Transmitting Machinery, including Shafting, Rope Transmission, Machine-Cut and Moulded Iron and Steel Gears for heavy service.

Almost sixty years' experience and competent engineering advice is at your disposal.

CRESSON-MORRIS COMPANY
Engineers—Founders—Machinists
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"THE CHAIN OF DOUBLE LIFE"
Fits cut and Standard C. L. Sprockets—1 to 12 in. pitch.



Union Steel Rivetless Chains

High Carbon Links (STRENGTH), Large Glass-hard Reversible Bearings (DURABILITY), One-piece Rivetless Construction (PERMANENCY) insure TROUBLE-PROOF, MONEY-SAVING SERVICE Bushing Chains, Roller Chains, Sprockets, Buckets, Elevators, Conveyors, etc.

The Union Chain & Manufacturing Company, Seville, Ohio
30 Church Street, New York Telephone, Cortlandt 892

FLEXIBLE STEEL TUBING

For Supplying Lubricant to Machine Tool Cutters

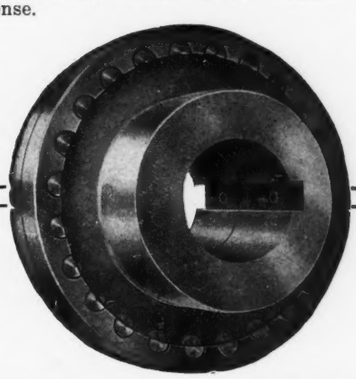
Strong, durable and warranted tight. No packing. All steel construction. Made in sizes ⅛ to ¾".

We are supplying many big machine tool builders—why not you? Write for details and samples.

WHEELOCK MFG. CO., Wheelock, Vt.

REAL FLEXIBILITY

in connecting the shafts of any two close coupled machines eliminates the expense of extremely careful alignment and provides for misalignments, which cause trouble and expense.



FRANCKE

FLEXIBLE COUPLINGS

for any size and type of direct power drive, are flexible in three directions in addition to providing a cushion for the driving shocks.

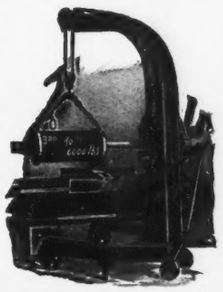
New Bulletin No. 26 lists sizes for all usual drives.

Smith-Serrell Co., Inc.
General Sales Agent for the Francke Co.
144 Cedar St., New York City

Are Working Conditions a Factor?

The Canton Portable Floor Crane takes the place of a half dozen men in lifting and hauling heavy objects to any part of the shop. Goes where an overhead cannot.

Powerful — reliable — easy to operate — the Canton is strictly a one-man machine. Moderate prices.



Catalog E-10 for details

CANTON FOUNDRY & MACHINE CO., Canton, Ohio

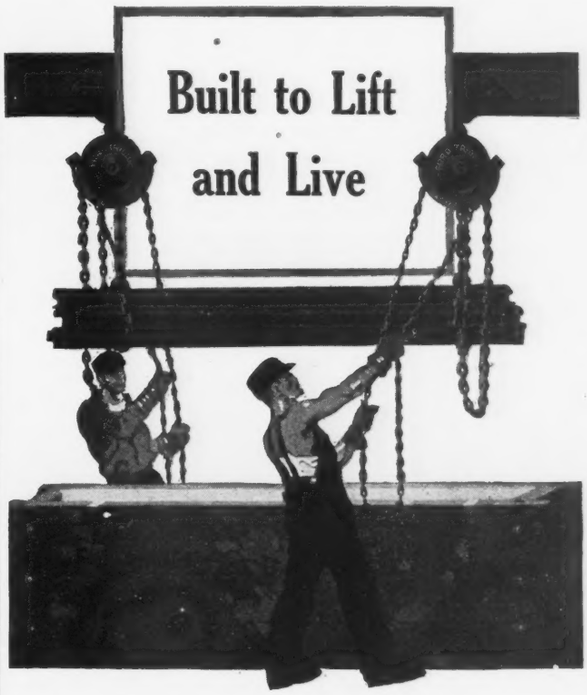
"TOLEDO CRANES"

FOR EVERY SERVICE

They are quite Reliable

The Toledo Bridge & Crane Co.
2950 Dorr St. TOLEDO, OHIO

FORD TRIBLOC
CHAIN HOIST



THE spur gear operating mechanism, with steel gears, makes the Ford Tribloc the most highly efficient type of Chain Hoist marketed. Eighty per cent of the power applied to the hand chain is converted into lifting energy—a mere 82-pound pull of one man on the hand chain lifts a ton.

The important part about the efficiency of the Ford Tribloc is that its original high efficiency is maintained longer than in any hoist, due to the patented **LOOP Hand Chain GUIDE.** This Loop Guide prevents "gagging" of the hand chain at all speeds and angles and protects the blocks.

For long, strong service specify the Ford Tribloc. We back our claims with a 5-year guarantee. Have you our Catalog?

FORD CHAIN BLOCK & MFG. CO.
Second and Diamond Sts. Philadelphia, Pa.

OVER-SEAS REPRESENTATIVE
ALMACOA ALLIED MACHINERY COMPANY OF AMERICA ALMACOA
120 BROADWAY, NEW YORK, U.S.A.

2126-D

THE SHAW ELECTRIC CRANE COMPANY

WORKS MUSKEGON, MICHIGAN

SALES OFFICES IN ALL PRINCIPAL CITIES

MANNING, MAXWELL AND MOORE, INC.

PRINCIPAL OFFICE - 119 WEST 40TH. ST., NEW YORK.



Let the Wright High Speed Steel Hoists Lift the Loads

150% more efficient than any other Hand Hoist. High speed steel and malleable iron parts—special design and construction—make for longer life and better service.

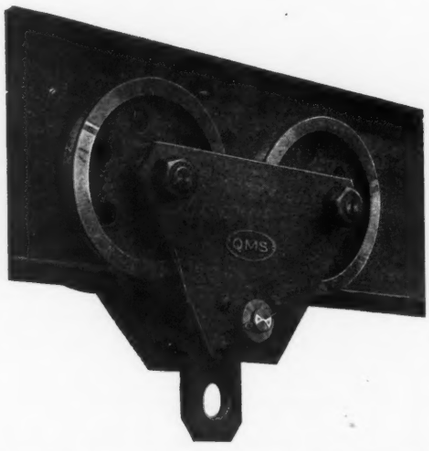
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WRIGHT HOISTS

Manufactured by

WRIGHT MFG. COMPANY

LISBON OHIO



QMS TROLLEYS

Strong, Durable, Efficient

Built in both plain and geared styles. Capacities ranging from one quarter to seven tons. In making inquiry state I-Beam size and style of trolley desired.

Write or wire now

VULCAN ENGINEERING SALES COMPANY

1763 ELSTON AVE. CHICAGO, U.S.A.

Sales Agent for

Hanna Engineering Works — Mumford Molding Machine Company

The QMS Co. — J. C. Busch Company

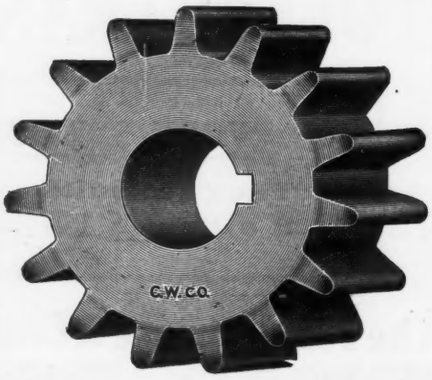
Cullman Sprockets

in stock and to order



For Block, Roller and High Speed Silent Chains. New Catalogue.

CULLMAN WHEEL CO., 1339 Altgeld St., Chicago



Use The Same Judgment



when buying a hoist that you would use in employing a man for a big job. Search its reputation for reliability and record of past performances. You will find in applying this test to

Peerless Hoists

that the enviable and unparalleled reputation they have controlled for many years past is due solely to the merit of design, material and workmanship.

No cast or malleable iron used to carry the load.

Suppose you let us demonstrate this hoist to prove to your satisfaction our claim is fully warranted.

Edwin Harrington, Son & Co.
Incorporated
Philadelphia Pa., U. S. A.

Cranes and Hoists

Electric Traveling Cranes.
Hand Power Traveling Cranes.
Bucket Cranes.
Jib Cranes.
Monorail Cranes.
Electric Hoists.
I-beam Trolleys.
Track Systems.
High Speed Chain Hoists.

Alfred Box & Co., Inc.
PHILADELPHIA, PA.



Quick Work!

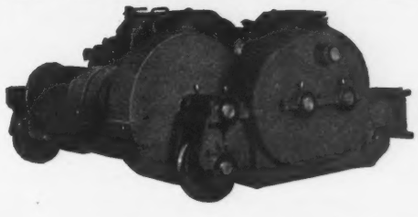
Quick and Easy. Lift with Cyclone Hoists—save time and labor.

CYCLONE HOISTS
HIGH SPEED

Sizes ¼ to 40 tons. Distributors in all cities. Catalog M gladly mailed on request.

The Chisholm-Moore Mfg. Co.
CLEVELAND, O.
Hoists Cranes Trolleys

NORTHERN CRANES!



Has your crane a modern ship-shape safety trolley like this? This is our

"Type E" Crane Trolley

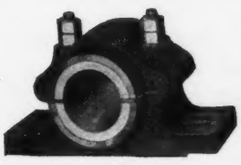
Made along up-to-the-present lines with all features of safety and efficiency demanded by good engineering practice. Learn more—get our catalogs. We also make



ELECTRIC HOISTS
Air Hoists, Foundry Equipment, etc.

Northern Engineering Works
6 Chene Street Detroit, Mich.

Power Transmitting Machinery


Heavy Pillow Block

Heavy bearings, drop hangers and post hangers.

Machine moulded gears and pulleys.

Friction clutches, rope drives and chain drives.

H. W. CALDWELL & SON CO.
Elevating, Conveying and Power Transmitting Machinery
17th Street & Western Avenue, Chicago, Ill.
50 Church St., New York 709 Main St., Dallas, Texas

CRESCO CHUCK

The Quickest—The Simplest

Ground All Over

Perfectly Balanced



Entirely self contained. No screws in the whole construction.



Superlatives are usually unconvincing. We want you to *try* the new Cresco Chuck. We'll give you your money back if it isn't the simplest and quickest drill chuck you have ever seen.

Tools are immediately released by simply raising the loose collar, thus permitting the hardened steel balls, which hold the collet in cross grooves, to fall back into it. The grip, as quickly effected, is positively secure.

Perfect balance insures absolute freedom from vibration at maximum speeds

Wire for price. Order a Cresco Chuck *today* on our money-back guarantee.

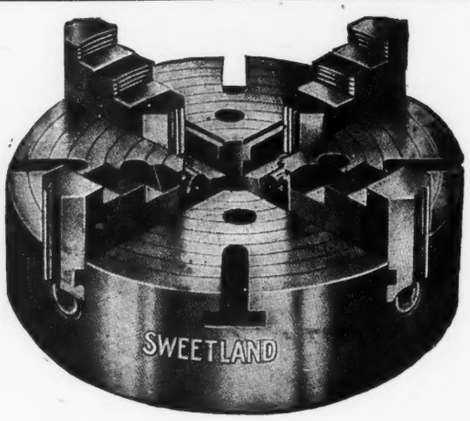
CHICAGO RECORDING SCALE COMPANY

Waukegan, Illinois, U. S. A.

A Grip on Production

STANDARDIZATION is a milestone in mechanical progress. Standard machines and standard parts have made predetermined production standards possible. Take a grip on *your* production. Find the best equipment and make it universal in your plant. For lathe chucks, of course, you'll want Sweetland. They're standard in high production shops everywhere.

Convenience, adaptability and reliability are the marks by which the Sweetland Lathe Chuck is known. Do *you* profit by these features?



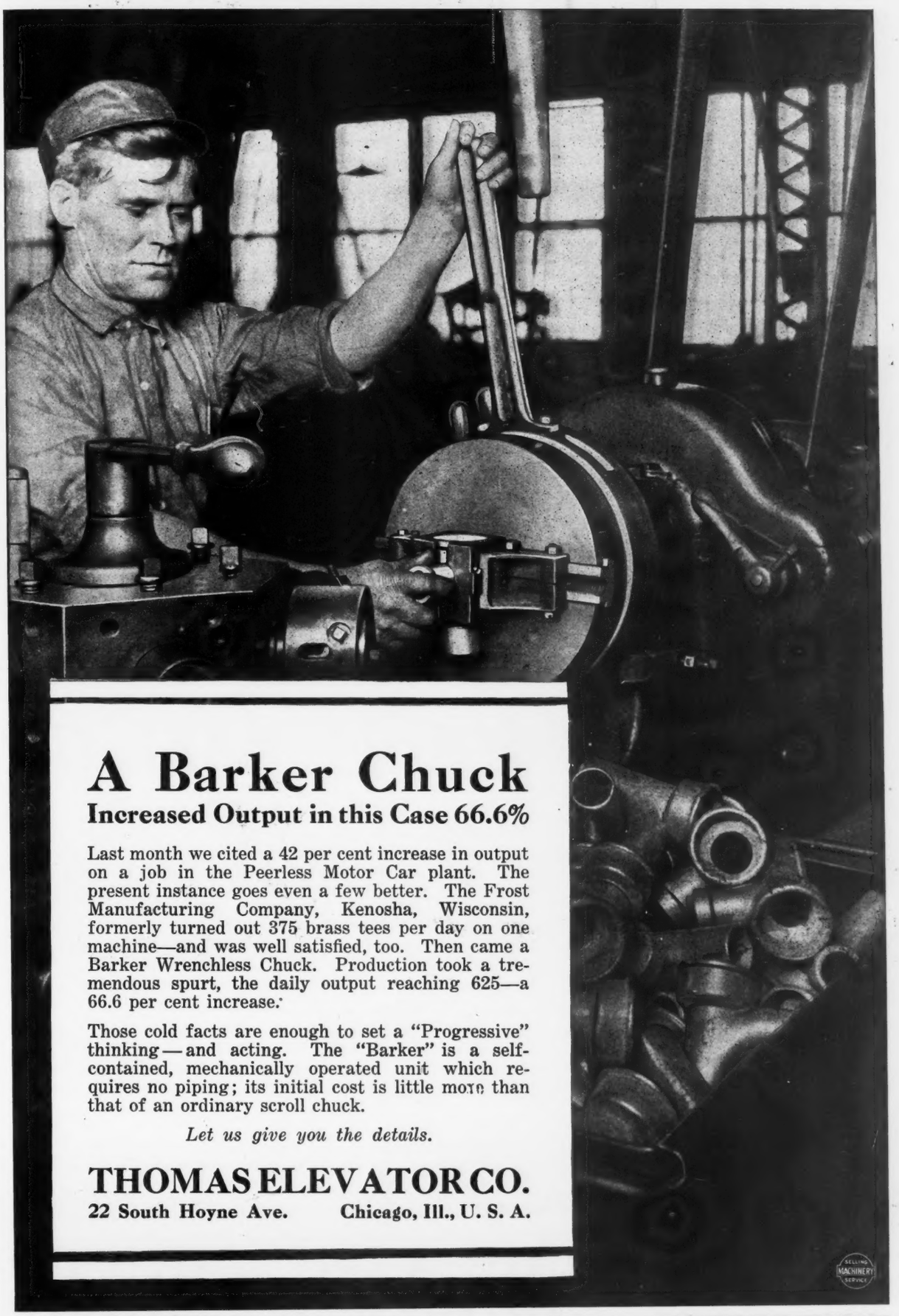
"Chucking for Profit" will interest you if you're interested in maximum efficiency.

Send for it today and get some helpful chucking data straight from headquarters.

HOGGSON & PETTIS MFG. COMPANY

NEW HAVEN CONNECTICUT, U. S. A.

SWEETLAND LATHE CHUCKS



A Barker Chuck

Increased Output in this Case 66.6%

Last month we cited a 42 per cent increase in output on a job in the Peerless Motor Car plant. The present instance goes even a few better. The Frost Manufacturing Company, Kenosha, Wisconsin, formerly turned out 375 brass tees per day on one machine—and was well satisfied, too. Then came a Barker Wrenchless Chuck. Production took a tremendous spurt, the daily output reaching 625—a 66.6 per cent increase.

Those cold facts are enough to set a "Progressive" thinking—and acting. The "Barker" is a self-contained, mechanically operated unit which requires no piping; its initial cost is little more than that of an ordinary scroll chuck.

Let us give you the details.

THOMAS ELEVATOR CO.

22 South Hoyne Ave. Chicago, Ill., U. S. A.



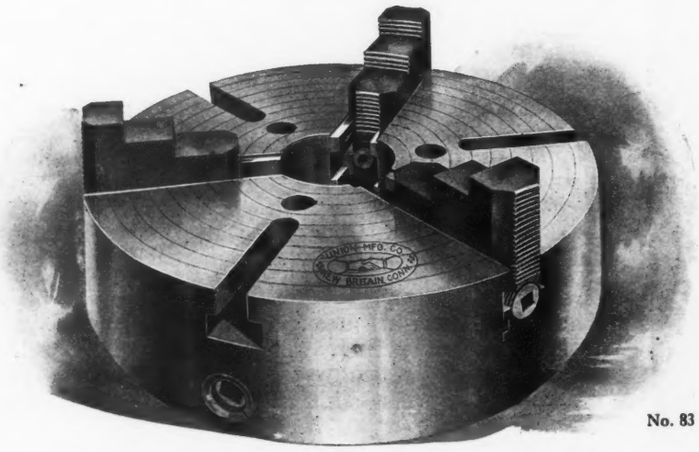
IF IT'S A CHUCK WE MAKE IT!

Chucks of every description, standard or special; chucks of any size.

We make chucks, have been making them for years and are equipped to furnish a "Union" Chuck that will fill your needs to the letter—and allow a margin for futures.

Accurate, strong, durable and adaptable — "Union" Chucks never fail to make good.

Catalog lists full line.



No. 83

The Geared Scroll Chuck illustrated combines the features of the Universal Chuck and the "Independent" and has, in addition, the special convenience characteristic of all Union Chucks. No. 83 with 3 jaws—No. 84, 4 jaws.

UNION MANUFACTURING COMPANY
NEW BRITAIN CONN., U. S. A.
NEW YORK OFFICE: 26 Cortlandt Street

GRADUATED ADJUSTABLE FRICTION SELF-CENTERING

TAP HOLDER FOR TURRET LATHE

ERRINGTON

MECHANICAL LABORATORY

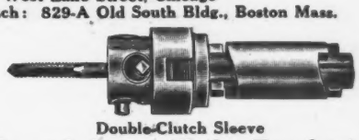
39 CORTLANDT STREET, NEW YORK

136 West Lake Street, Chicago

New England Branch: 829-A Old South Bldg., Boston Mass.

TAPS STEEL as Safely as Cast Iron

Regulates the Whole Power of Machine to Just Drive, but Cannot Break Tap. When Tap Sticks (or Strikes Bottom) the FRICTION SLIPS, and Tap can thus be Run In and Out until the Toughest Metal is Quickly Tapped.



Double-Clutch Sleeve



Interchangeable Spring Shank for Rough and Finish Taps occupying One Turret Hole

Especially Good for Roughing and Finishing Taps, Running Solid Dies Up Against a Shoulder, etc.



Hit the Bottom with Your Tap. Use the Bottom of the Hole for a Stop.

The "Double Gripp" Safety Tapping Attachment

WON'T LET IT BREAK

One of our records is 90,000 holes without breaking a tap.

Saves the tap, the cost of removing same and oft-times the material.

Also made for a Reversible Drill Press or Tapping Machine.

WILLIAM L. PROCUNIER

549 W. Washington Blvd., CHICAGO

In stock and for sale by Young, Corley & Dolan, Inc., 115 Broadway, Manhattan district representatives; Barnes Saw and Equipment Co., Detroit, Mich.; M. Jaeger, Cleveland, Ohio; McKeen Machinery Co., Pittsburgh, Pa.



The Chuck That Never Slips.

The More You Crowd it, The Tighter It Grips.

NARRAGANSETT MACHINE CO.

PROVIDENCE, R. I., U. S. A.

1874 TRUMP DRILL CHUCK 1918

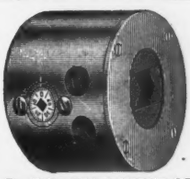


We have been making it for 44 years; it is still the BIG Chuck at the SMALL price; for Straight or Taper Shank Drills.

Three Sizes	No. 1	No. 2	No. 3
	0 to ⅛"	0 to ½"	0 to ⅝"

Write for prices and particulars

TRUMP BROS. MACHINE CO. Wilmington, Del.



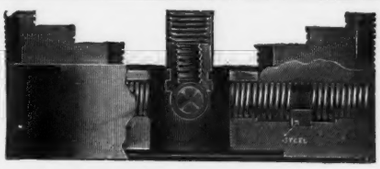
Flynn Offset Boring Heads

This chuck, which has a micrometer adjustment and large range, is strong, durable and easily operated.

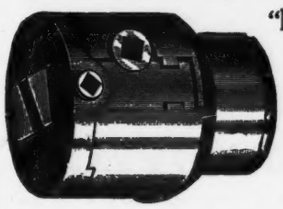
Write for free circular

J. M. WATERSTON, 77 Woodward Ave., DETROIT, MICH.

Solid Steel Rings Reinforce these Independent Lathe Chucks



making them strong where other chucks are weak, providing for tensile stresses and screw thrusts, insuring greater durability and better service.



"National" Round Body Drill Chuck

Made with three distinct grips which can be applied at the same time when neccessary—a positive gripping chuck—all sizes up to 2 inches. *Catalog?*

Oneida National Chuck Co.

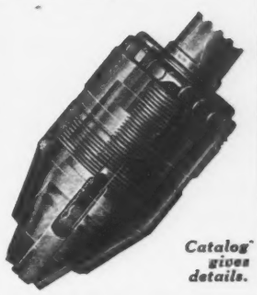
ONEIDA N. Y., U. S. A.

Don't Lose Time With Keys and Wrenches

Eclipse Roller Bearing Drill Chucks

are quickly tightened or released by simply using the thumb and forefinger. Speed and convenience of the tightening operation do not lessen the security of the grip.

GROUND ARBORS FOR ALL KINDS OF CHUCKS.

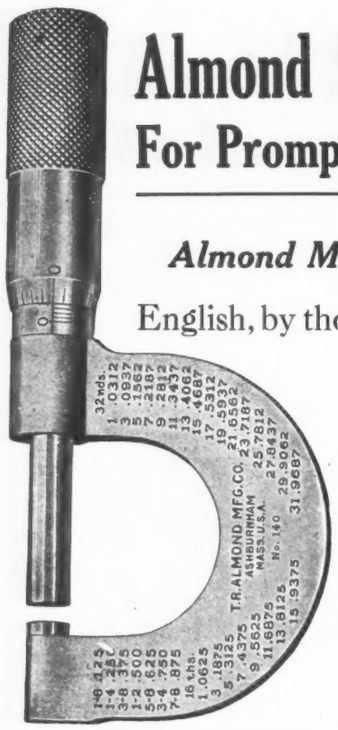


Catalog gives details.

Nielsen-Barton Chuck Co.

106 South Jefferson Street

CHICAGO ILLINOIS



Almond Specials
For Prompt Delivery

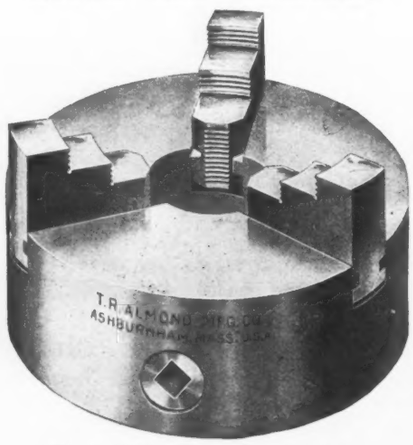
Almond Micrometers

English, by thousandths and ten-thousandths, 1, 2 and 3 inch.

Metric, by 1/100 mm. —25, 50 and 75 mm.

With or without Ratchet Stop.

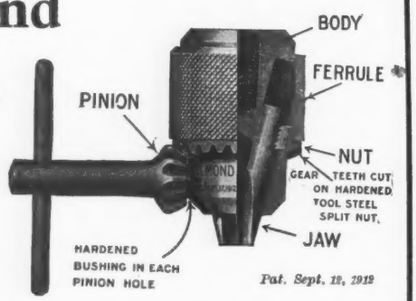
Almond Universal
Scroll Lathe Chucks



5, 6, 7½ and 9 inch sizes

Almond
Geared Nut Drill Chucks

Powerful
Accurate
Durable and
Economical
to Maintain
Try One



Pat. Sept. 12, 1912

Details of Whole Almond Line on Request

T. R. ALMOND MFG. CO.
2 Maple Ave. Ashburnham, Mass., U. S. A.

Drill Chucks
Lathe Chucks
Portable Face Plate Jaws

**Many Styles and Sizes.
All Designed for Hard and Exacting Service.**

Catalog Free

THE CUSHMAN CHUCK CO.
HARTFORD CONN., U. S. A.

The VICTOR



Collapsible Tap

The Victor Collapsible Tap is a sure remedy for most tapping troubles. Like other good taps, it cuts a clean, sharp thread—but there is *not a chance* of it then ruining that thread, as solid taps often do in backing out. The other big reason for using Victor Collapsible Taps is the time they save. They eliminate the "return trip" time on every operation.

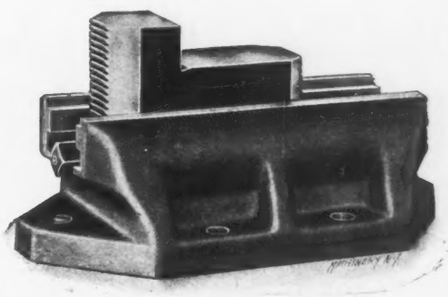
Just take a pencil, if you please, and figure out what this would save you a day in your tapping operations. You will then see why the Victor Collapsible Tap pays for itself.

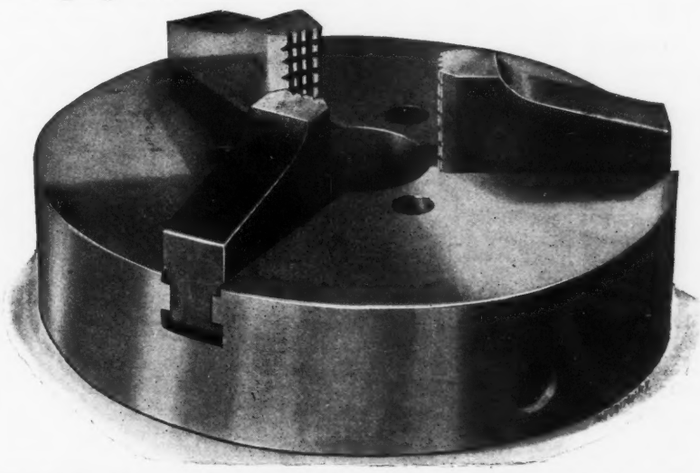
The Catalog tells you more. Write for it.

VICTOR TOOL COMPANY
Waynesboro Pa., U. S. A.

A HORTON Chuck for Every Purpose

All have distinctive "Horton" features—strength, convenience and durability—adapted to the requirements of each specific class of work. In this heavy duty chuck, the scrolls and pinions are heat treated and oil hardened to give the extra strong grip necessary for bar and forging work.





HORTON
Face Plate Jaws

have helped solve a lot of chucking problems. They have extra provision for clamping and strapping, are pointed—to permit holding small diameter work—and can be used interchangeably on different faceplates.

Catalog of full Horton line on request.

THE E. HORTON & SON CO., Windsor Locks, Conn., U. S. A.

PRATT CHUCKS
Drill Without Waste or Worry



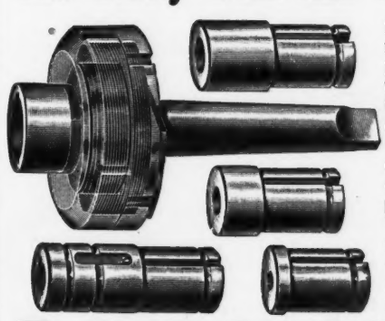
The Pratt Positive Drive Drill Chuck is especially adapted for high speed drilling. It grips securely, drives without vibrating—without danger to work or tool—and leaves drill shank clean and free from scar. It saves time, too.

Make your next chuck order read "Pratt"

THE PRATT CHUCK CO., FRANKFORT, N. Y., U. S. A.

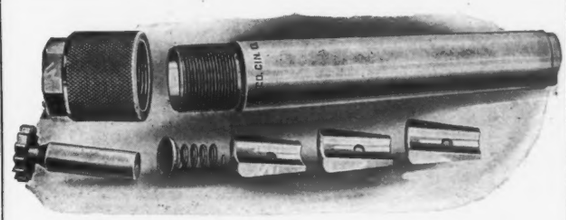
Sales Representatives: Surpless Dunn & Co., Chicago. New York
EUROPEAN AGENTS: Selson Engineering Co., Ltd., 85 Queen Victoria Street, London, England.

The Safety Drill and Tap Holder



is the only attachment for the purpose that gives universal satisfaction and is unequaled in efficiency, convenience, rapidity, accuracy and simplicity. Nothing to break or get out of order. Made in 4 sizes, covering from 0 to 2½ inches diameter.

The Beaman & Smith Co. PROVIDENCE Rhode Island



How Do You Hold Your Woodruff Keyseat Cutters and Other Tools with ½" Straight Shanks?

LOOK

This chuck is made with a taper shank either B & S or Morse to fit the spindle of your machine. The design is such that the jaws do not fall together, but allow free entrance of the shank at all times.

Send for our Catalogue and get acquainted with our tools

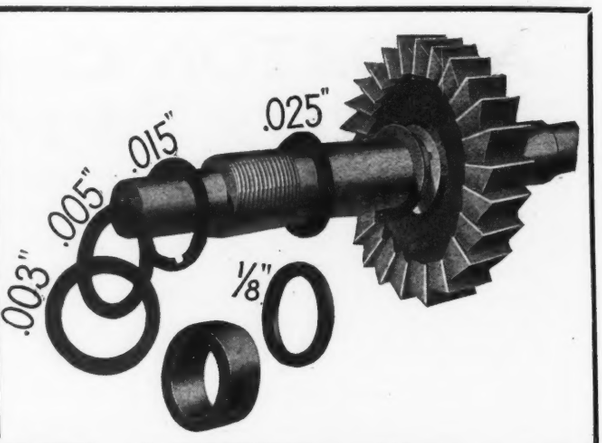
THE ADVANCE TOOL CO.
Canal & Jackson Sts., Cincinnati, Ohio
Agents wanted in all principal cities

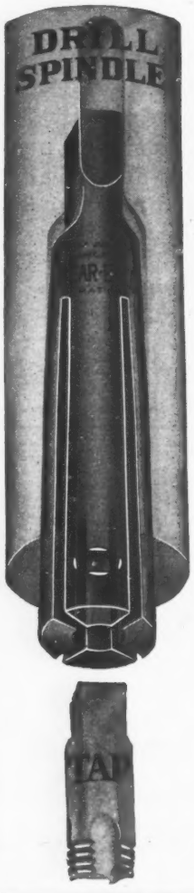
Don't Make Washers—Buy Them

You'll find it a whole lot quicker, cheaper and less trouble to buy your spacing washers than to have them made in your own shop.

Stock Sizes—with or without standard keyways—for arbors of the following diameters: 3/8, 1/2, 5/8, 3/4, 7/8, 1, 1 1/8, 1 1/4, 1 3/8, 1 1/2, 1 5/8, 1 3/4, 1 7/8, 2, 2 1/4, 2 1/2, 3 and 3 1/2 inches. Stock thicknesses: .003, .005, .015 and .025 inches. To order, .0015 to 3.000 inches.

DETROIT STAMPING CO.
951-957 West Fort Street DETROIT, MICH., U. S. A.





JUST a single piece of hardened metal—nothing to adjust, nothing to get out of order or wear. Any ordinary mechanic can quickly change taps with the

"WEAR-EVER"
Tap Chuck

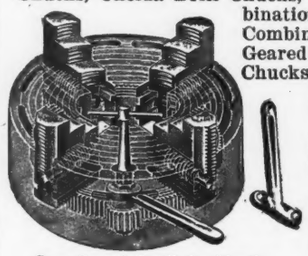
It drives true, every time—regardless of shank variation—is equally well adapted for taper reamers and other straight shank tools, reduces tool breakage to a minimum and is always ready for work.

9 Sizes—Morse Taper
Low Price—Investigate

SCULLY-JONES & COMPANY
647 Railway Exchange Bldg.
CHICAGO, ILLINOIS, U. S. A.

If You want the best Lathe or Drill Chucks—buy Westcott's

Little Giant Auxiliary Screw Drill Chucks, Little Giant Double Grip Drill Chucks, Little Giant Improved Drill Chucks, Oneida Drill Chucks, Spur Geared Scroll Combination Lathe Chucks, Scroll Combination Lathe Chucks, Spur Geared Scroll Universal Lathe Chucks, IXL Independent Lathe Chucks, Cutting-off Chucks.



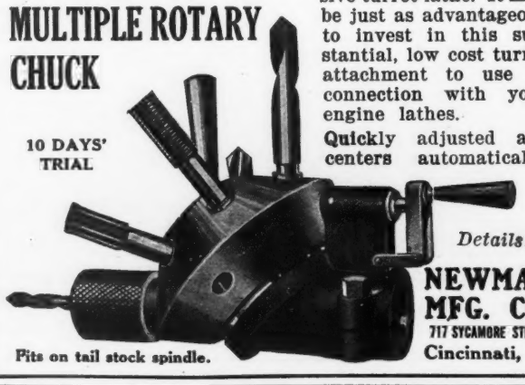
Spur Geared Scroll Combination Lathe Chuck

Strongest Grip, Greatest Capacity Great Durability and Accuracy

WESTCOTT CHUCK CO.
ONEIDA, N. Y., U. S. A.
Ask for Catalogue

THE NEWMAN MULTIPLE ROTARY CHUCK

10 DAYS' TRIAL



Pits on tail stock spindle.

Think twice before installing another expensive turret lathe. It may be just as advantageous to invest in this substantial, low cost turret attachment to use in connection with your engine lathes.

Quickly adjusted and centers automatically.

Details?

NEWMAN MFG. CO.
717 SYCAMORE STREET
Cincinnati, O.

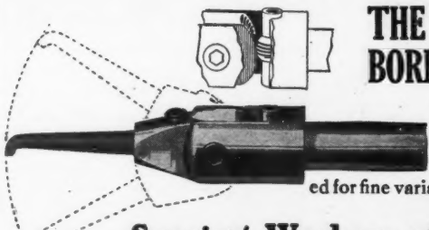


Electric Blue Printing Machines

Write for Catalogue B-2

Buckeye Engine Co.
Salem, Ohio

THE E-Z SET BORING TOOL



Three sizes—straight or taper shank. Easily adjusted for fine variations. *Details?*

Spacing Washers

Accurately cut. 1, 1¼, 1½ and 1¾ inches diameter; 3, 4, 5 and 6 thousandths thick. $3.00 per 100, 25 of each thickness.



The Maxwell-Hutchcroft Company
1227 W. 9th St., Cleveland, Ohio, U. S. A.



The

"WOODSTOCK"

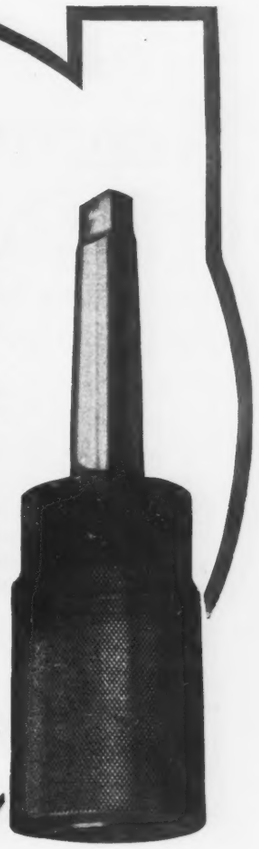
For Cylinder Tapping

"No more broken taps since we use the Woodstock Tapping Chuck." This comes officially from the Loew Victor Engine Company, apropos of cylinder tapping.

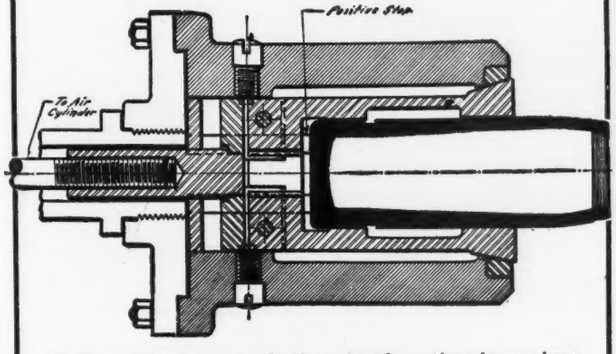
Requirements were 66 holes of three sizes and a high percentage on tap breakage made it an expensive operation until "Woodstock Tapping" proved the solution, as it invariably does, whether threading cored holes in castings—subject to "soft and hard spots"—or those troublesome shallow holes where an automatic stop on the machine is utterly useless.

Try a "Woodstock" 30 days "on us" and put it at your most expensive tapping job. Write for details.

PETER BROS. MFG. CO.
135 Railroad Avenue
ALGONQUIN ILLINOIS



Save Time—Chuck Instantaneously



Shell manufacturers and others to whom time is precious, but accuracy even more so, have found that

M. E. C. Air Operated Collet Chucks and Short Expanding Mandrels

save one and insure the other. They are quick-acting, positive, and adapted for all classes of work; save 90 per cent of chucking time and increase production accordingly.

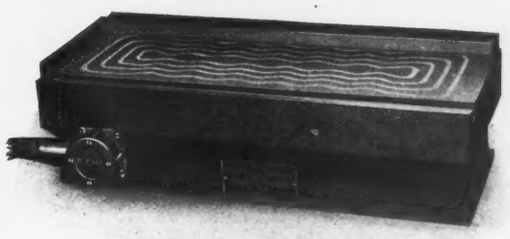
We're getting repeat orders from all quarters of the earth—that's the ultimate proof of efficiency.

Full details on request

MANUFACTURERS EQUIPMENT CO.
200 N. Jefferson St. CHICAGO, ILL.

AGENTS FOR EASTERN STATES AND CANADA: J. R. Stone Tool & Supply Co., Goebel Bldg., Detroit, Mich.; also 30 Church St., New York.

Increased Production Is the Big Idea Today



"D & W" Magnetic Chucks dispense with the needless delay of adjusting clamps and bolts. They have solved many a problem of rush work in shops throughout the country. They can help you in your shop.

If you want to save time, increase production and grind more accurately you will find that "D & W" Magnetic Chucks will do the same for you as they have for others, viz.: speed production, and they are proof against adverse shop conditions, heat, moisture, oil, etc.

Write for Circular No. 206-M, describing them

D & W FUSE COMPANY
PROVIDENCE RHODE ISLAND

Buy The

Wahlstrom Drill Chuck

You Can't Buy Time, But You Can Buy Production

Wahlstrom Automatic Drill Chucks increase production. They grip and release tools while the spindle is running. They employ no keys, collets or sockets, are entirely self-contained and can be used wherever drill chucks are needed. Tools are automatically centered. All parts are interchangeable.



If you are interested in fast, safe chucking methods, write us at once.

WAHLSTROM TOOL COMPANY

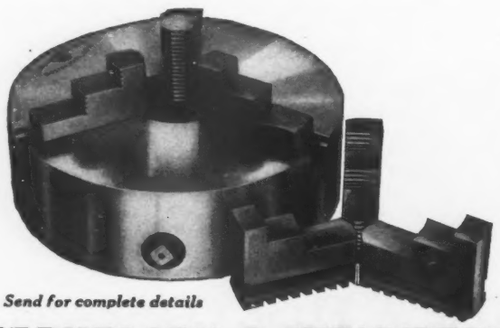
5520 Second Ave.
BROOKLYN, N. Y.

T & W



Chucks That Are Right

Best material and workmanship throughout. Thousands now in use. Sizes 2½ to 15 inches.



Send for complete details

TERKELSEN & WENNBERG
BOSTON, MASSACHUSETTS

Don't Let Rust Eat Up Your Profits

Which are they doing? Those machines and tools of yours—wearing out or rusting out? Our Sherardizing process prevents needless rust. Let us demonstrate on samples of your work.

WISE ELECTRO SHERARDIZING CO.
120 Eighth Street DETROIT, MICH.

Better Light *for* Half the Price

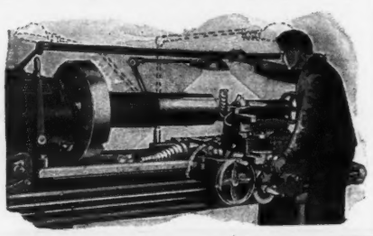
is the claim we are prepared to substantiate by a trial offer

THE NEWMAN SPOTLIGHT

concentrates the light just where it is required, does not shine in the operator's eyes, is readily attached to any light plug and cuts your light bills 50 per cent.

Ask for details

We make bench brackets also.



NEWMAN MFG. CO.
717 Sycamore Street
CINCINNATI, OHIO

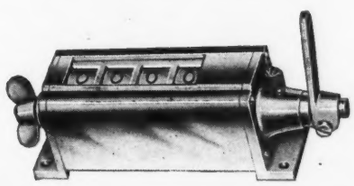
Making More of Your Man-Power

The amount of work your machine operator will do depends on the amount of incentive you can furnish him, and the amount of money he can see coming to him.

Let him see his wages go up before his eyes—let him watch his production run up on a Veeder Counter—and the incentive is there because the *assured reward* is there.

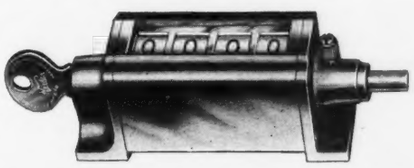
You satisfy your operative that he's paid for all he does—and in satisfying the operative you make more of your man-power. The worker acquires new value as a producer when his machine acquires a

Veeder
COUNTER



The above Set-Back Rotary Ratchet Counter registers one for each throw of the lever, corresponding with the operations of your machine. The counter for punch presses, metal-stamping machines, etc. Reset to zero by turning knob, and supplied with any number of figure-wheels up to ten. Price, with four figure-wheels, $9.50 (list). With lock and keys to prevent tampering with figures, $1.50 extra.

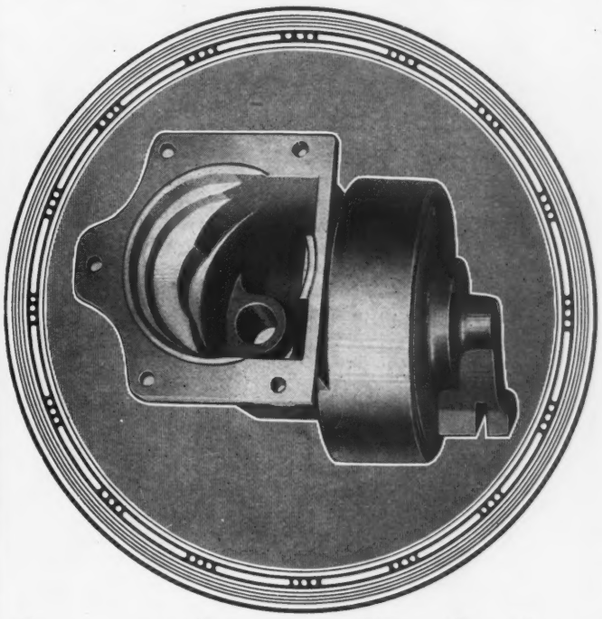
The Revolution Set-Back Counter below registers one for a revolution of a shaft, recording an operation of your machine. Set back to zero by turning key, and supplied with from four to ten figure-wheels, as required. The price, with four figure-wheels, lock and keys, is $9.50 (list). Without lock and keys, the price is $8.00.



The exact counter you'd want for this or that machine can be readily found in the Veeder booklet; like a copy?

THE VEEDER MFG. CO.
39 Sargeant Street, Hartford, Conn.

Pacific Coast Distributor: F. Somers Peterson Company, 60 Pine Street, San Francisco, Cal.



Stewart Process Die-Castings

The qualities essential to perfect die-casting are assured by the Stewart Process — accuracy — uniformity — strength —finish.

To be a source of economy, die-castings must combine all these qualities. They must be delivered in a perfect, finished state.

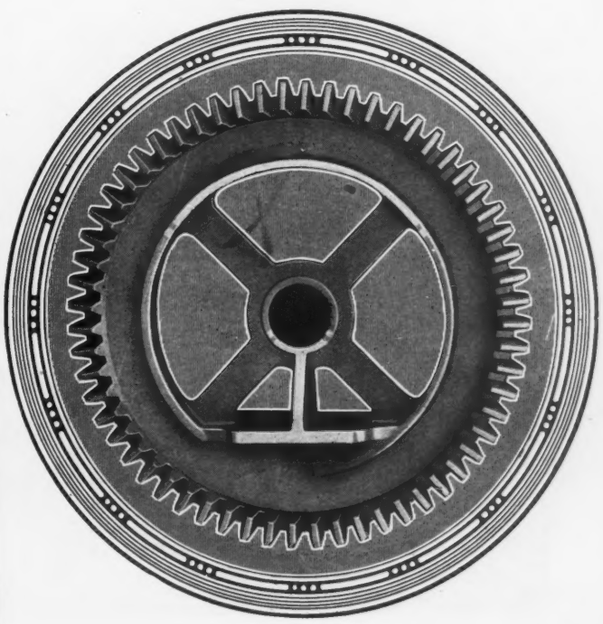
Stewart-made die-castings are cast automatically—every one alike—100% perfect.

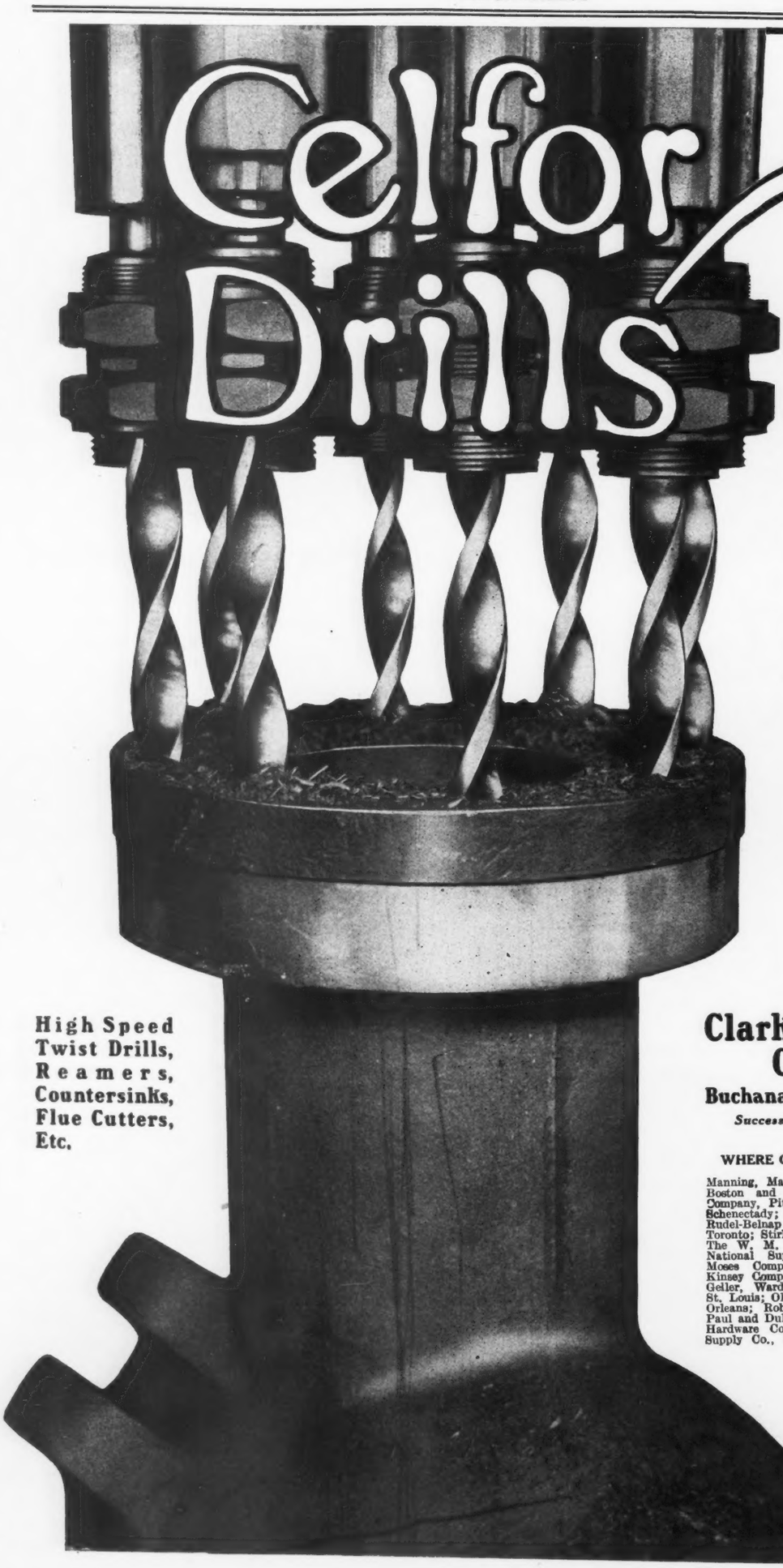
Unlimited facilities—rapid production—superior methods guarantee quick deliveries on large outputs.

Stewart Manufacturing Co.

Wells Street Bridge **Chicago, U. S. A.**

Stewart





One Grinding a Day Is Enough

It takes these drills only one and three quarter minutes to penetrate the solid two inch flange on this Triplex Plunger Pump — Goulds Manufacturing Company, makers—and only one grinding per day is required.

Of course the Drills are

CELFOR

High Speed Twist Drills

The Goulds Company uses them exclusively for holes ½" and over.

High Speed Twist Drills, Reamers, Countersinks, Flue Cutters, Etc.

Clark Equipment Company

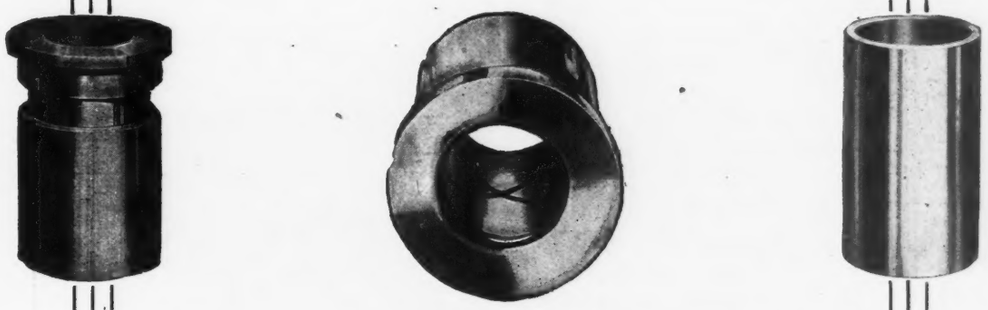
Buchanan Michigan

Successor to Celfor Tool Company

WHERE CELFOR TOOLS ARE SOLD

Manning, Maxwell & Moore, Inc., New York, Boston and Philadelphia; Machinists Supply Company, Pittsburgh; Clark-Witbeck Company, Schenectady; H. D. Taylor Company, Buffalo; Rudel-Belnap Machinery Co., Montreal and Toronto; Stirling-Warfel Mill Supply Co., Erie; The W. M. Pattison Supply Co., Cleveland; National Supply Company, Toledo; Everett Moses Company, Birmingham; The E. A. Kinsey Company, Cincinnati and Indianapolis; Geller, Ward & Hasner Hardware Company, St. Louis; Oliver H. Van Horn Company, New Orleans; Robinson, Cary & Sands Co., St. Paul and Duluth; J. C. Dolan, Denver; Seattle Hardware Company, Seattle; Pacific Tool & Supply Co., San Francisco and Los Angeles.

The more they are used, the less it is necessary to say about them; for pre-eminence in men or products needs no lengthy eulogy.



BUNTING

Finished Bronze Bushings and Bearings

Patented

The Bunting Brass & Bronze Co.

748 Spencer Street TOLEDO, OHIO

Try Us On Bevel Gears



We've specialized on bevel gears. Our very large capacity and the fact that hundreds of thousands of our bevels are standard parts on leading automobiles, machine tools and other machinery, places us in a peculiarly advantageous position to fill your requirements.

Our equipment provides for generating the correct shape of tooth which assures the highest quality of workmanship and for a rapidity of production which makes our prices attractive. Give us at least a chance to figure on any quantity, size, pitch and finish.

NEW PROCESS GEAR CORPORATION
SYRACUSE, N.Y.

78

WE EXCEL IN
FORGED GEAR BLANKS

Because:

1. We use the best material procurable.
2. We employ skilled workmen.
3. We fill all orders *exactly* as per specifications.
4. We have concentrated on this product for years and *you* get the benefit of our experience.
5. We take as much pains with small orders as we do with big ones.
6. We make shipment absolutely when promised.
7. Our prices are reasonable.

WRITE US.

THE MACHINERY FORGING CO.
Hamilton Ave. and Marquette St.
CLEVELAND, OHIO, U. S. A.



Long Service Gears

We use only the best materials and our machining and heat-treating equipments are the latest approved models. Renewals are few and far between with Cincinnati Gears. Another point—Prompt Deliveries—should interest you.

Write for Catalog C

THE CINCINNATI GEAR CO.
1827-1833 Reading Road
CINCINNATI OHIO, U. S. A.

Hindley Worm Gearing

Complete drives with housing ready for power

ALBRO-CLEM ELEVATOR COMPANY
501 Erie Avenue East PHILADELPHIA, PA.

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Mill Drives Turbine Transmissions
Spur Gears Bevel Gears Worm Gearing
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Quiet the Noisy Gear Drives With
NEW PROCESS NOISELESS PINIONS

With the whole world longing for peace, start in your own shops to eliminate the gear noises that war on the efficiency and productiveness of your employees.

Our booklet "Noiseless Gear Driving" is a real war manual that should be in the hands of every enemy of unnecessary and destructive noise and vibration in machine drives. Send for your copy.

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ALL gears wear out eventually. Economically speaking, therefore, the vital consideration in buying gears is to buy gears that will give the longest service.

Grant Gears are durable even under severe usage. They are made from selected materials in a plant equipped to turn out quality gears. Grant carries in stock Iron Cut Gears, Brass Cut Gears, Cast Gears, and makes gears to order, all sizes from ¼" to 6' diameter, any face. Reasonable prices, prompt deliveries and gears you can depend upon.

Send for Catalogue.

Grant Gear Works, Inc.
151 Pearl St., Boston, Mass.



Metal and Rawhide GEARS

For all-round satisfactory gear service —accurate, long wearing gears of any desired metal or best commercial rawhide—prompt deliveries and reasonable rates, send your specifications to

STAHL

Metal Gears—spurs up to 60" dia., 2 D. P.; bevels up to 24" dia., 1¾ D. P.; spirals and herringbone gears up to 19" dia., 3 D. P.; worms up to 18" dia., 3 D. P.; racks 8' long 4 D. P. Rawhide gears—any requirement up to 15" dia., 2 D. P.

Estimates Furnished Promptly.

THE STAHL GEAR & MACHINE CO.
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FOR DEPENDABLE SERVICE

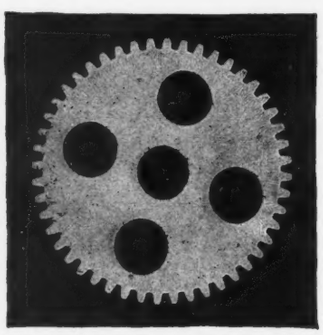


May we have an opportunity to quote on your gear requirements?

Accurate and Efficient

Our product is known wherever there is a demand for large quantities of medium and small size gears, to be made rapidly, economically and accurately.

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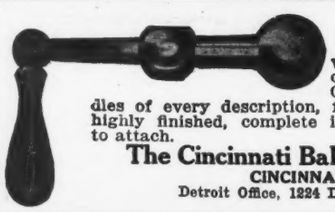
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Gear Cutting Department

(Cut is full size)

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with your present handle costs our prices for Ball Cranks and Machine Handles of every description, from bar steel. Accurate, highly finished, complete in every detail and ready to attach.

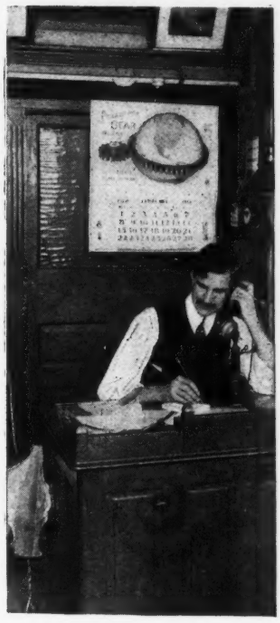
The Cincinnati Ball Crank Company
CINCINNATI, OHIO
Detroit Office, 1224 Dime Bank Bldg.



Gears and Gear Cutting

We guarantee satisfaction

RODNEY DAVIS, Philadelphia, Pa.



PHILADELPHIA GEAR *TIME*

"Every Second Counts"



Phillie Gear is Always on the Job

From Order Desk to Shipping Platform

Phillie Gear doesn't keep bank presidents' hours. Not infrequently he's at his desk before the men show up—he plans the best way to railroad the day's rush orders for gears and assigns all work. He's in and out of the shop till quitting time—bossing each job, literally from start to finish. He's quick to note and commend any unusual proficiency and no industrial slacker ever escapes his watchful eye.

When he wants to relax a little, he goes to the shipping platform. The satisfaction of speeding finished gears upon their way never loses its zest for Phillie Gear—especially if he knows they'll give the customer a glad surprise by arriving ahead of schedule.

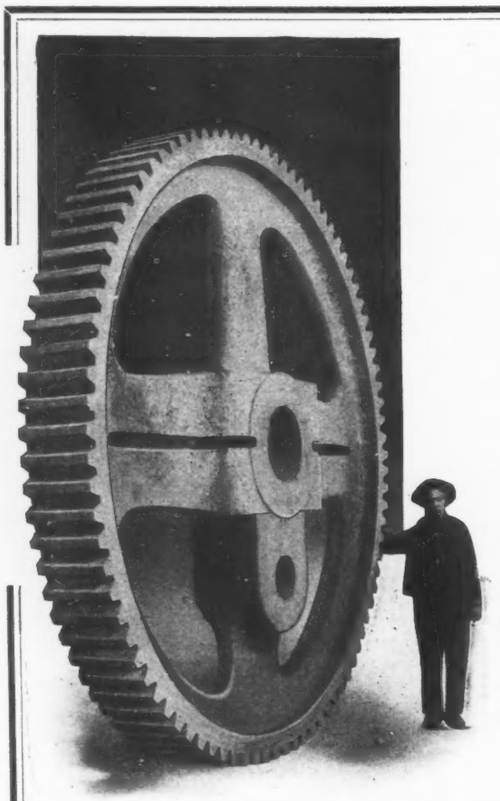


Specify "Philadelphia" on that very special order and Phillie Gear will have it under his eye from start to finish.

Let us send a catalogue, and if you don't see what you want in the catalogue, ask us to make it special.

Philadelphia GEAR Works 1120-1128 Vine St. Philadelphia

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There's a world of satisfaction in knowing, when you place an order, that you are getting what you want—and the maker is working with you to see that you get the best possible in every way—price, quality, service.

The size or type makes no difference—if it is a gear, we can make it.

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AD "Zones of Quiet"

Accurately Generated GEARS





Wherever you find Albaugh-Dover Accurately Generated Gears in use, you are sure to be impressed with their unusual smoothness and silence in operation. Our gears are used by many of America's leading manufacturers of automobiles, trucks, tractors and other machinery. If you use gears—SPIRAL, HELICAL, INTERNALS, WORM OR WORM WHEELS—send us your blueprints or sample gears for estimates. We operate our shops continuously day and night in three shifts of 8 hours each, insuring exceptional service.

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Screw Machine Products Up to 5½"



All the way from a giant channel dredging machine to the delicate mechanism of the wireless, every class of mechanical development contains Meisel gears.

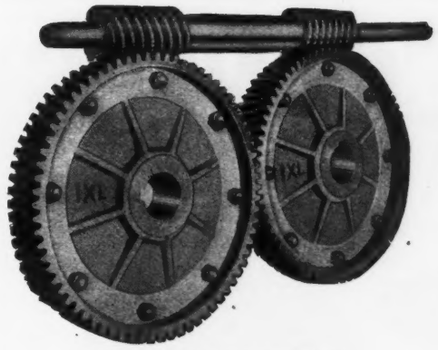
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QUALITY—EFFICIENCY
Goes with Every IXL Cut Gear

IXL Quality Cut Gears

ALL KINDS—ANY SIZE—FOR EVERY PURPOSE
WHERE QUALITY IS PARAMOUNT

Their superiority is backed by careful study, long experience, unrivaled facilities and immense production. *Get our prices before you buy.*

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Makers of the IXL Products

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Equipped to Handle All Kinds of

Special Machine Work

We make the unusual machinery that other shops are not now equipped to handle.

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SAVE WHAT'S LEFT OF YOUR MILLING CUTTERS

Send them to us to be recut without being annealed. We specialize also in end mill salvage. Try us on whatever of these old tools you now have on hand. *Prompt deliveries.*

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BEVEL GEAR GENERATORS. BEVEL GEARS

CUT THEORETICALLY CORRECT

Special facilities for cutting Worm, Spiral, Miter, Internal and Elliptical Gear Wheels

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Cut Gears, Racks, Worms, Worm Gears, Special Machinery, Motor Gears *and* Pinions



Who Makes Your Screw Machine Products?

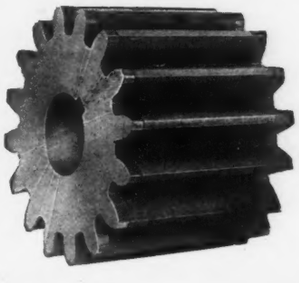
We have the facilities and equipment and are prepared to "speed up" orders for screw machine products in quantities. More details on request.

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NEW HAVEN CONN., U. S. A.

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We're doing our bit to keep things humming in the home shops—making *prompt deliveries* on all kinds, styles and sizes of gears.



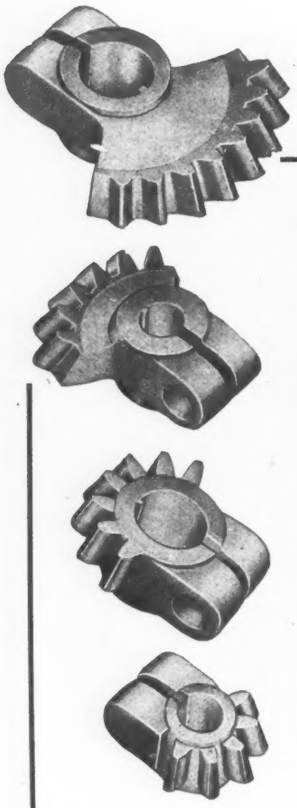
Peerless Rawhide or Cut Metal Gears

Peerless Rawhide Pinions meshing with cut metal gears make a very desirable drive for high speed machines. Our "Blue Book on Gearing" tells all about it.

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LICENSED TO MAKE BAKELITE MICARTA GEARS



In Aluminum or White Metal Alloy

Best Way to Produce GEARS

There are few parts of machines as difficult to produce as gears. This group of sprocket gears shown here is no exception.

They must be accurate. Every tooth is exact in depth and pitch. Every projection and depression is true and smooth. The old method of machining such parts is too slow and uncertain. Progressive manufacturers now use the

Acme Die-Casting Process

Accuracy Guaranteed

Produced in steel dies under great pressure in wonderfully constructed machines, these castings meet the most exacting requirements of the manufacturer and are indispensable to quick production and economic efficiency.

If you are doing government work it will have preference at our factory.

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Quality *First*

COWLES TOOL COMPANY
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HINDLEY GEARS

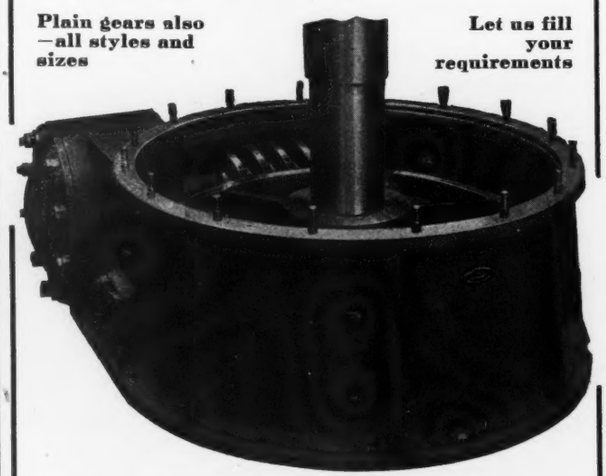
Best for Important Services

Hindley Gears are being used in the most important services of the day—in airplanes, submarines, army trucks, etc.

Their dependability is a known quantity. That's why.

Plain gears also—all styles and sizes

Let us fill your requirements



Hindley Gear Company
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Steel for Service

Good Gears Aid Maximum Production

In these days when our national welfare is dependent in a large measure upon our ability to co-ordinate all of our resources and exert every effort to obtain maximum efficiency from every machine, the question of what kind of gears to use is one of vital importance.

A sudden break in one of the gears and a machine or part of your plant is shut down until the gear can be replaced. Such delay reduces production. If a similar gear is not in stock, you are dependent upon the output of another plant and upon the uncertain transportation of the present day. Renewals of worn-out gears are equally expensive.

Gears made from

Carnegie Rolled Steel Blanks

wear three to seven times as long as cast steel gears, and if properly heat treated, never break. Good business policy dictates their use at all times.

Specify gears made from Carnegie Rolled Steel Blanks on your next order for gears.

Carnegie Steel Company

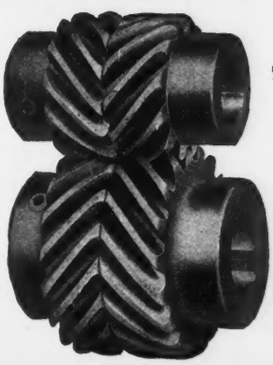
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SAFEGUARDING *the* SINEWS *of* WAR



NIGRUM
Trade Mark Reg. U. S. Pat. Off.
IMPREGNATED WOOD
OIL LESS BUSHINGS

IN this war—essentially a war of mechanics—we are staking the outcome against the fidelity of machinery. Airplanes, motor trucks, despatch cars, ambulances, tanks, tractors, cranes, hoists, battleships, cruisers, destroyers, submarines, each is playing a vital part.

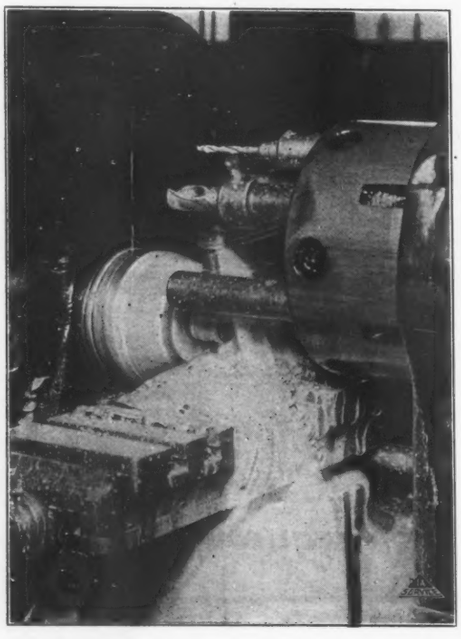
OIL-LESS Bushings are contributing no small share towards safeguarding these sinews of war. By protecting moving parts against breakdown, *even when neglected,* they eliminate the erring human factor with its potential capacity for harm. No oversight, inattention or sheer stupidity can stop or even retard their proper functioning—for they need no watching.



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OIL-LESS BUSHINGS

On those parts most liable to neglect or difficult ot access, OIL-LESS Bushings keep trouble away and maintain efficiency under every condition. And the safety of nations, no less than the success of battles, hinges on the ability of war's machinery to efficiently perform the serious task assigned it.

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Specialists in the manufacture of Oil-less Bushings for more than a third of a century.
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All Genuine Graphited Oil-less Bushings have always been made at Bound Brook, U. S. A.



How fast your tools travel depends a lot on the coolant

MYSTIC
Cutting Compound

has proved its worth as a speed promoter and a tool saver. Mystic increases output and lowers cost.

"You have tested the rest, now use the best." First shipment on approval.

Let us show you.

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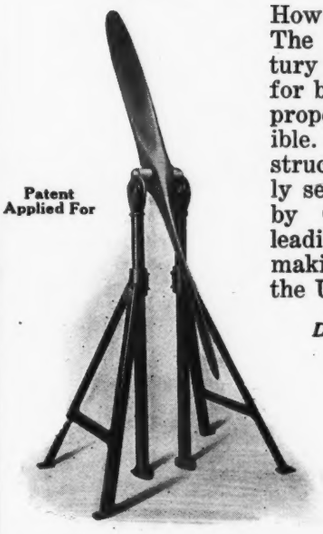
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The Twentieth Century Airplane Propeller Balancing Tool

BALANCE—important in any machine, MORE important the finer its adjustments and MOST important when the machine in question is an airplane.

How to achieve it? The Twentieth Century Balancing Tool, for balancing airplane propellers, is infallible. Durably constructed and extremely sensitive, it is used by Curtiss and the leading manufacturers making airplanes for the U. S. Government.



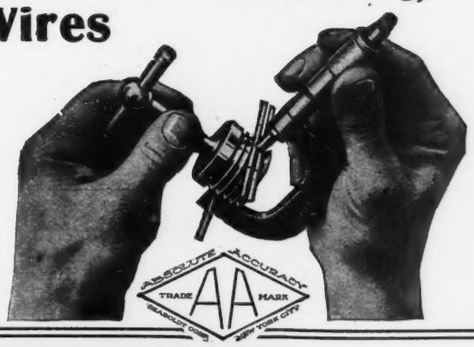
Patent Applied For

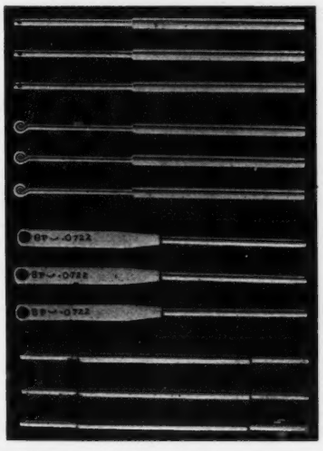
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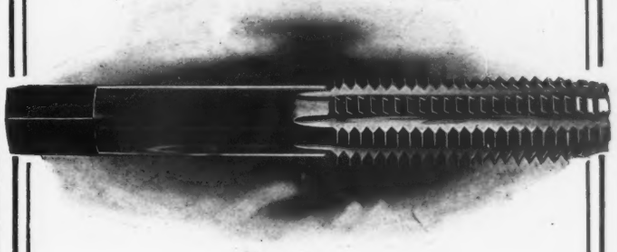


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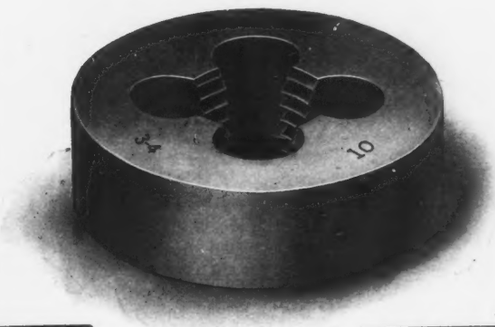
PUT to the test, our fighting forces in France have justified the nation's faith in them. Backed by the necessary production forces at home, they are exceeding expectations in meeting the demands imposed upon them, and in this general efficiency

BRUBAKER TAPS, DIES AND REAMERS

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MORSE DRIVES PROVIDE MAXIMUM DURABILITY AND EFFICIENCY

Positive as Gears **Flexible as a Belt**

SAVE POWER SAVE SPACE SAVE LIGHT SAVE LEATHER

THE LARGEST MANUFACTURERS AND STOCK OF SILENT CHAIN DRIVES IN THE WORLD. CONSIDER THE ADVANTAGE OF THIS AND OUR PROMPT DELIVERIES. THESE ARE VITAL FACTORS.

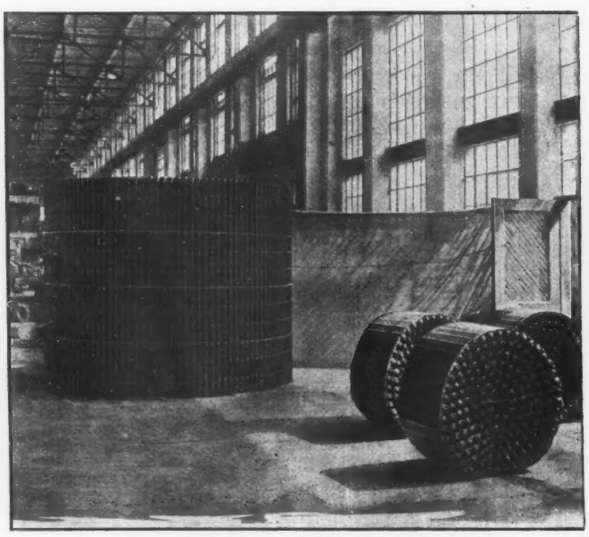
MORSE ENGINEERING SERVICE

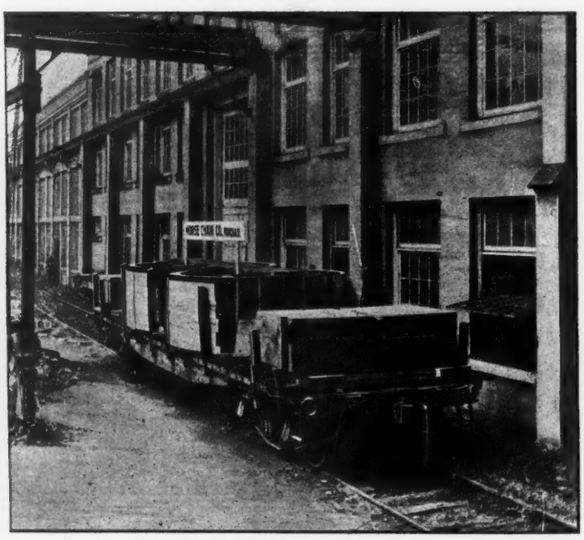
Aims by careful analysis and tests of your power service to determine the weak points and losses, submit reports designating changes to increase production with lower costs and maintenance and greater durability. Installing without interrupting work. Always glad to receive inquiries and furnish information or reports. All assistance free, without obligation.

THE MORE SEVERE THE DUTY THE MORE NEED OF "MORSE."—THE PERFECT, DURABLE, POSITIVE TRANSMISSION, WITH 99 PER CENT EFFICIENCY.

Morse Drives have great mechanical strength. Made of the best material available, assuring 100 per cent overloads.

SLIPPING BELTS MEAN HIGHER PRODUCTION COSTS, SHUT DOWNS ARE EXPENSIVE.





Ready for shipment, 1800 H.P. "MORSE" Drive

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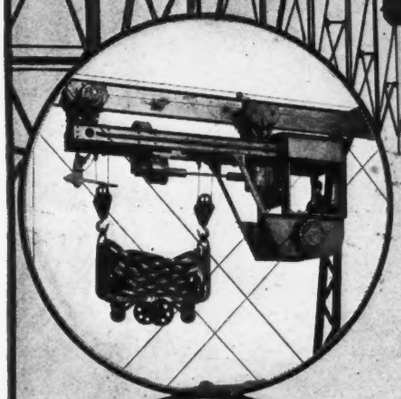
Morse Engineering Service *Assistance Without Obligation*

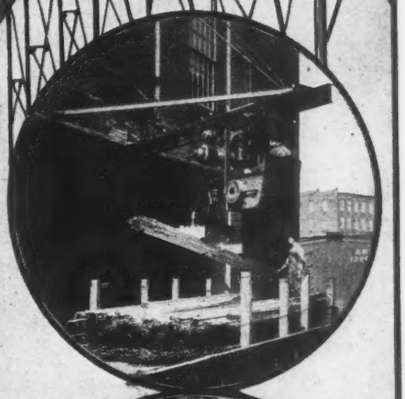
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"MORSE" is the Guarantee always behind our Service, Products and Efficiency

SHEPARD
ELECTRIC HOISTS

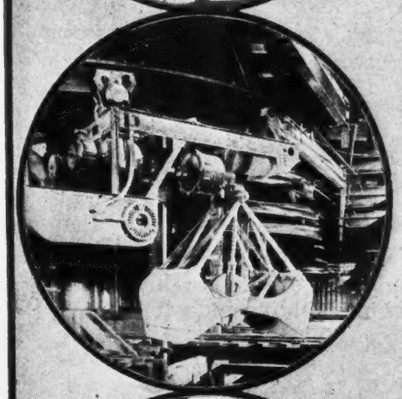


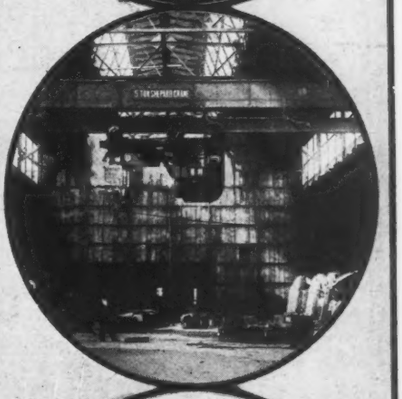


For Every Need

For hoisting machinery—for all kinds of work—the name of SHEPARD stands for absolute reliability and exceptional durability.

Whether the required capacity is large or small—whether the need calls for a monorail type, a traveling crane or a transfer bridge of great size or whether the requirements are for outdoor or indoor work SHEPARD apparatus is recognized as the best grade that can be made.

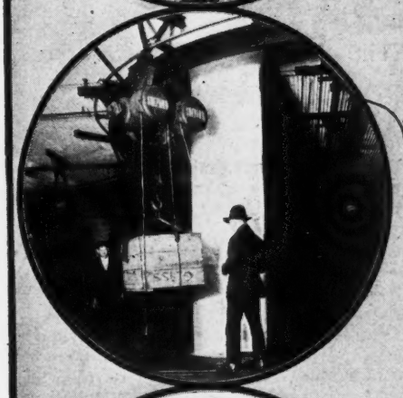


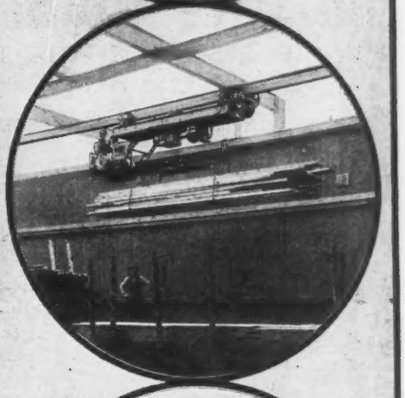


For Every Line

SHEPARD Hoists and Cranes are used in all lines of industry—Boiler Plants—Structural Plants—Foundries—Steel Mills—Shipyards—Paper Manufacturers—Textile Mills—Lumberyards—Wire Mills—Automobile Manufacturers and many others, including a total of more than 90 industries.

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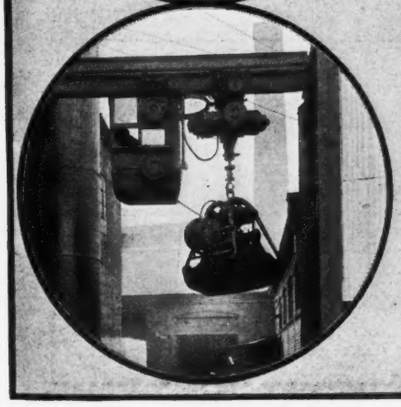


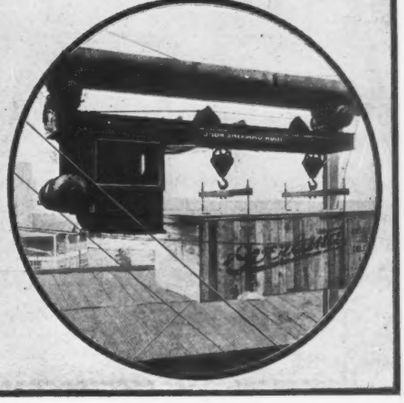


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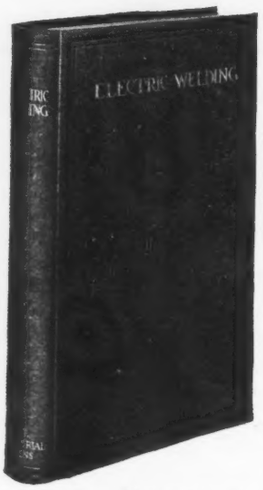


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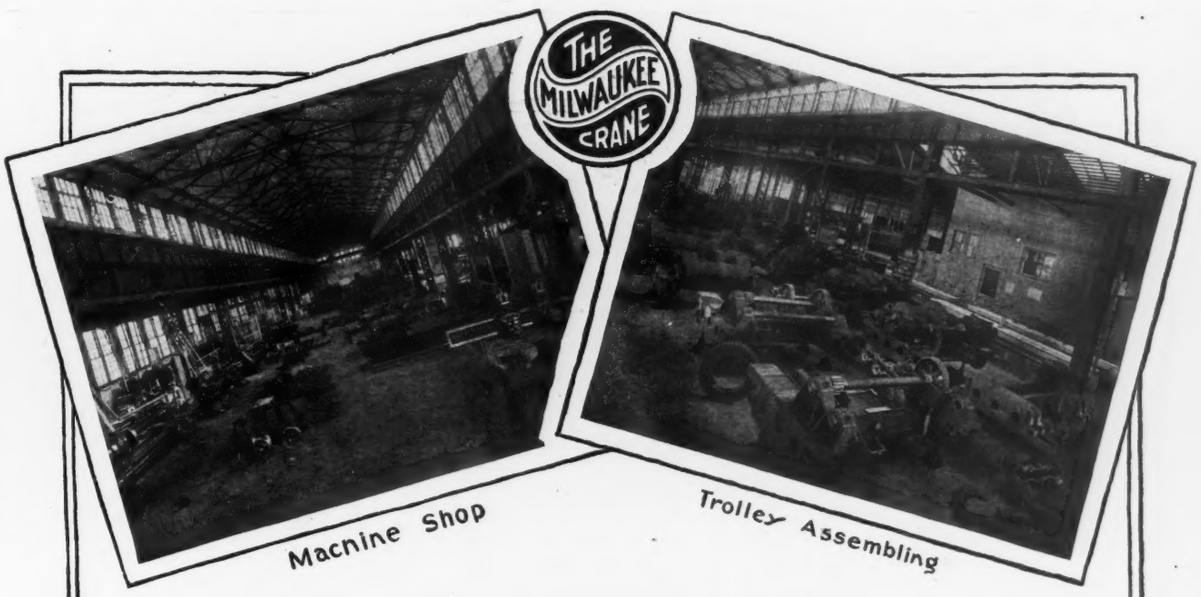
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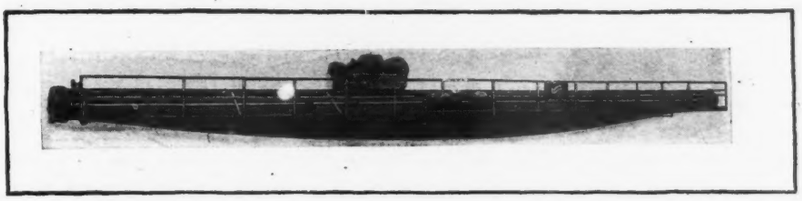
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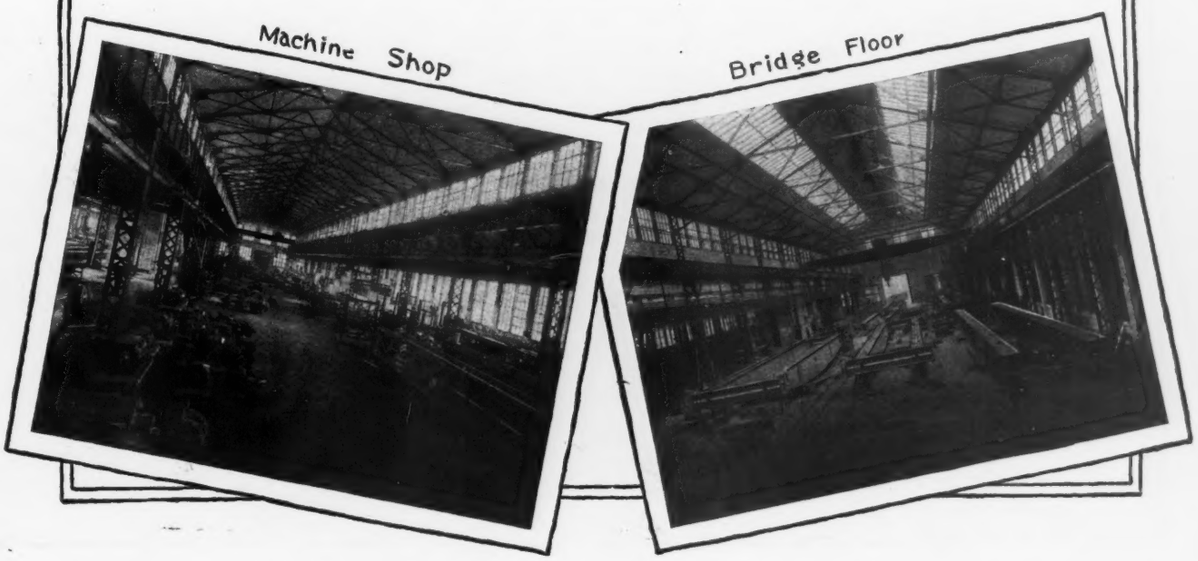
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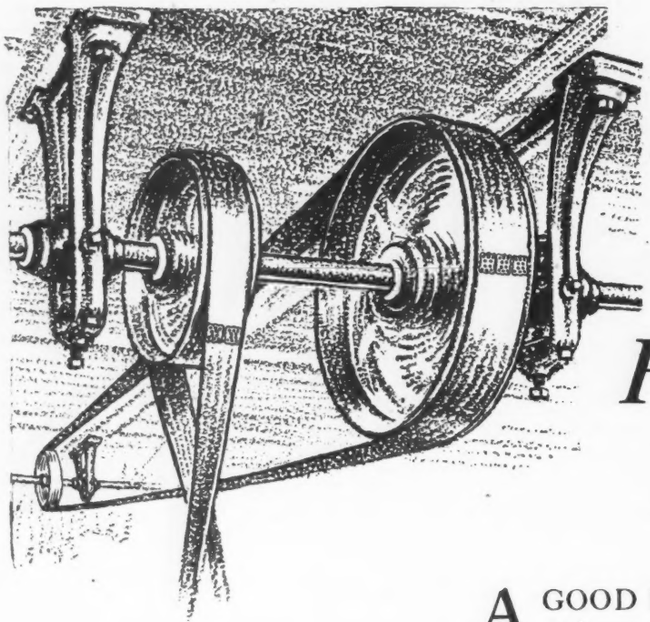
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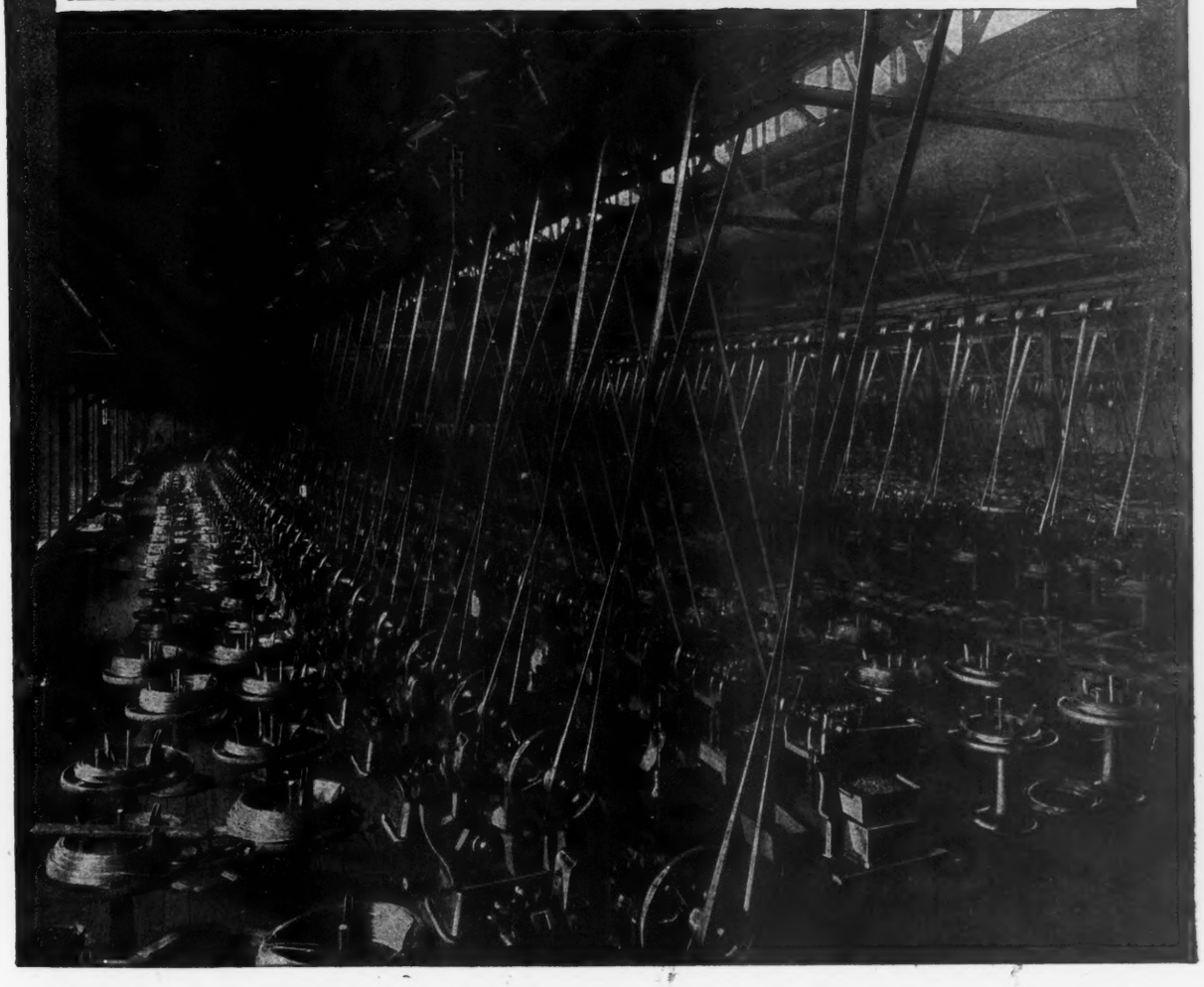
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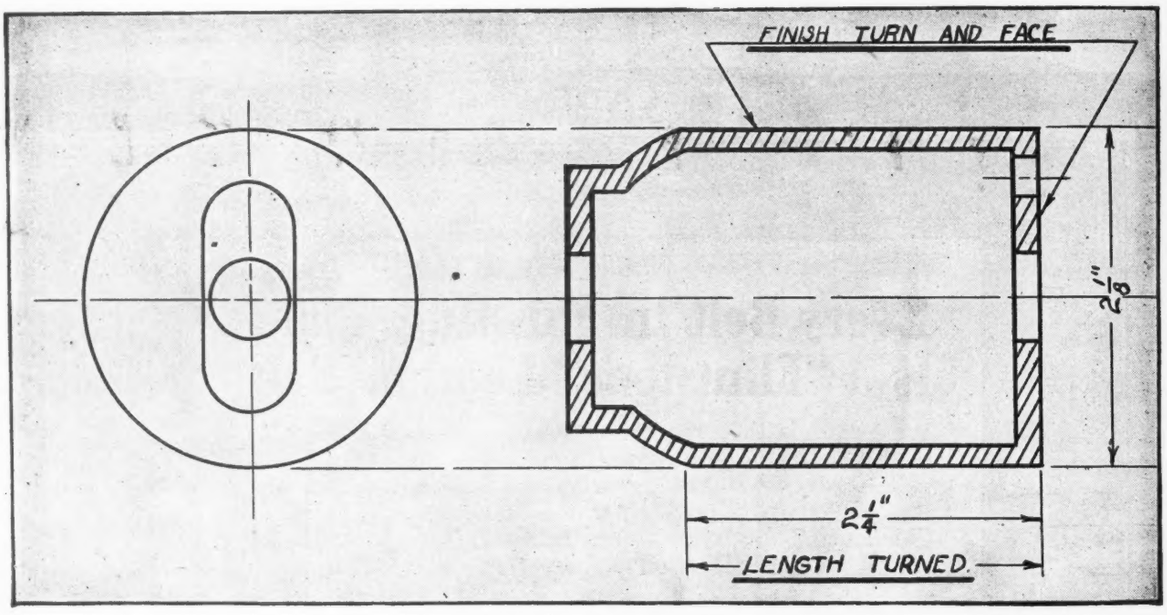
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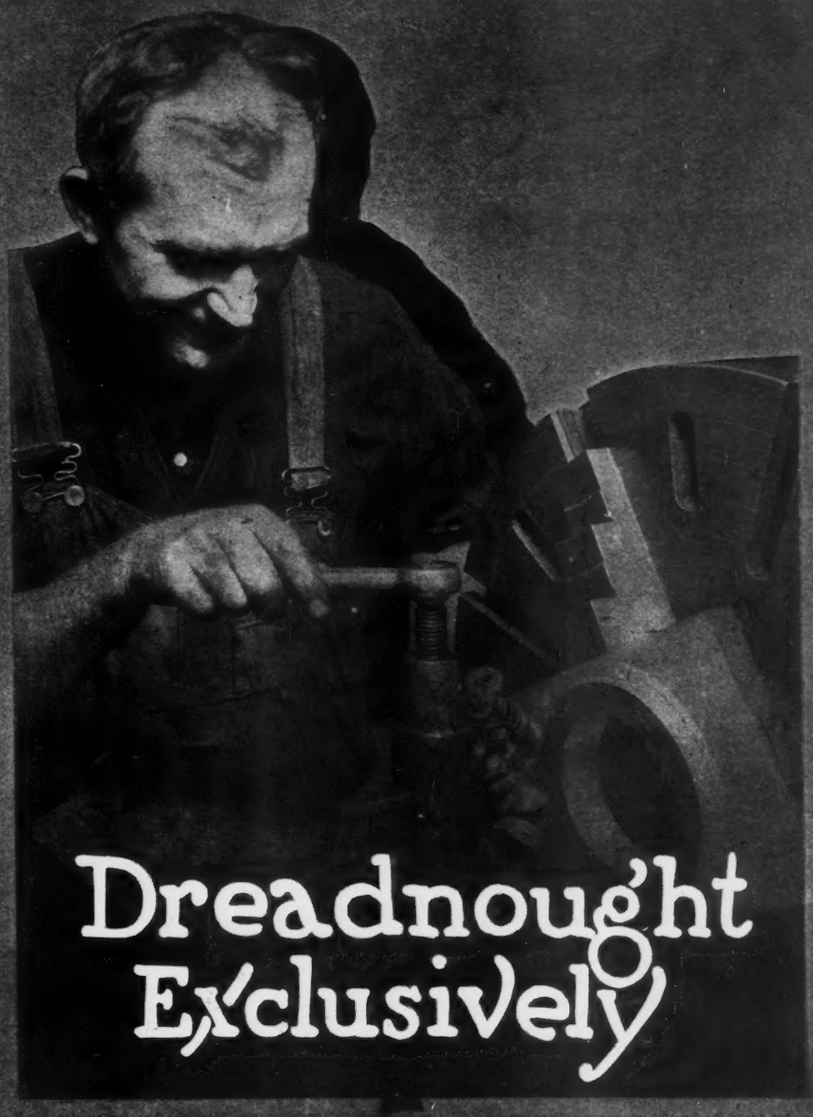
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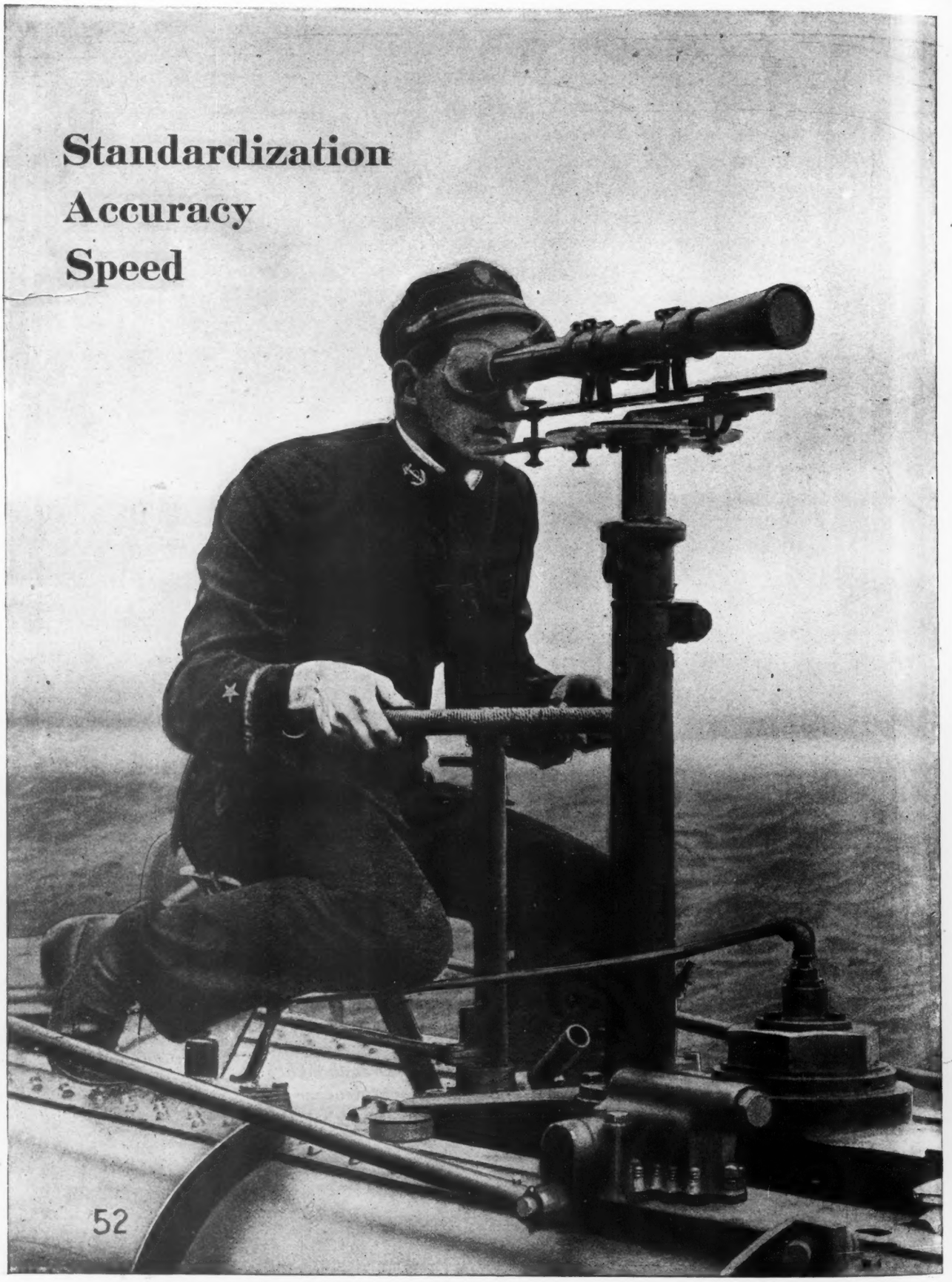
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Critical Moments

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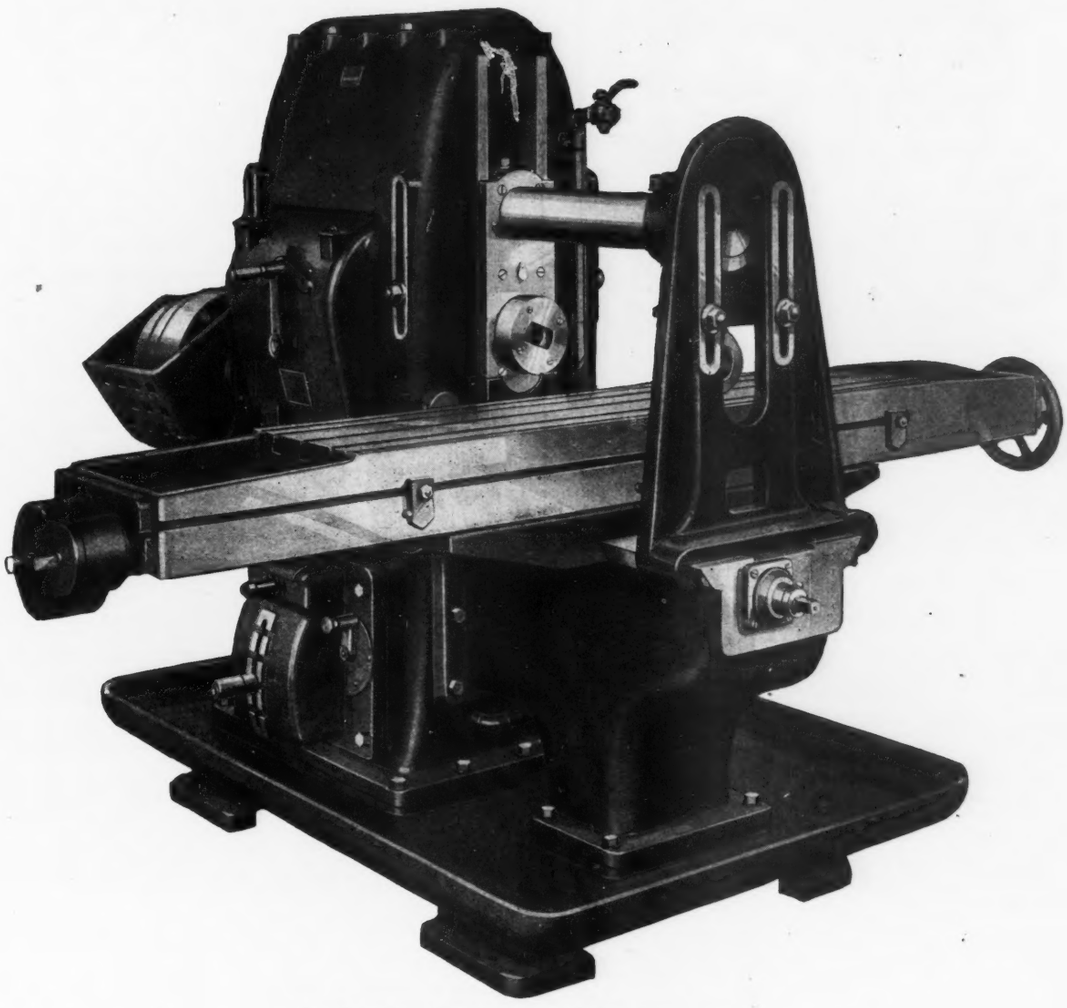
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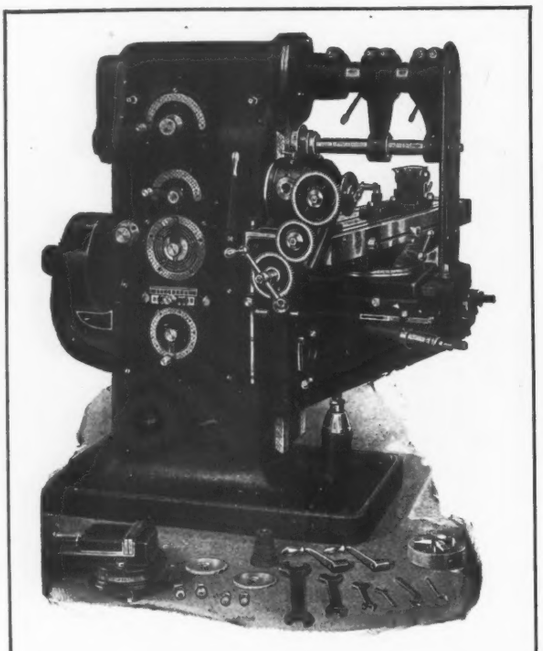
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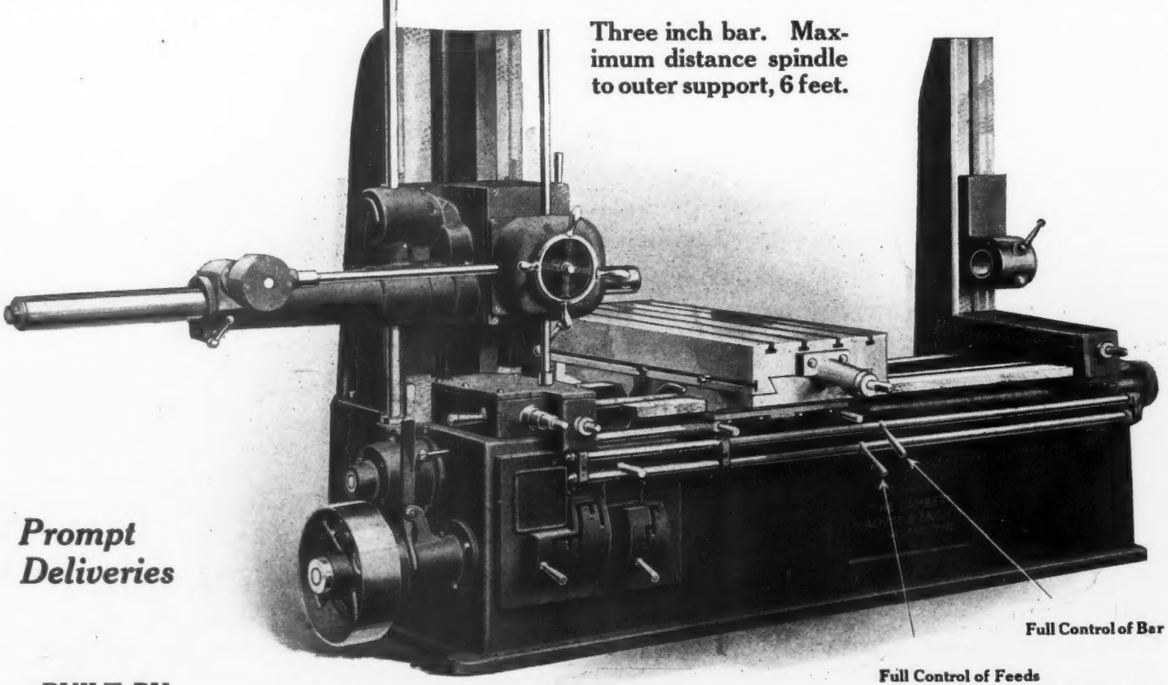
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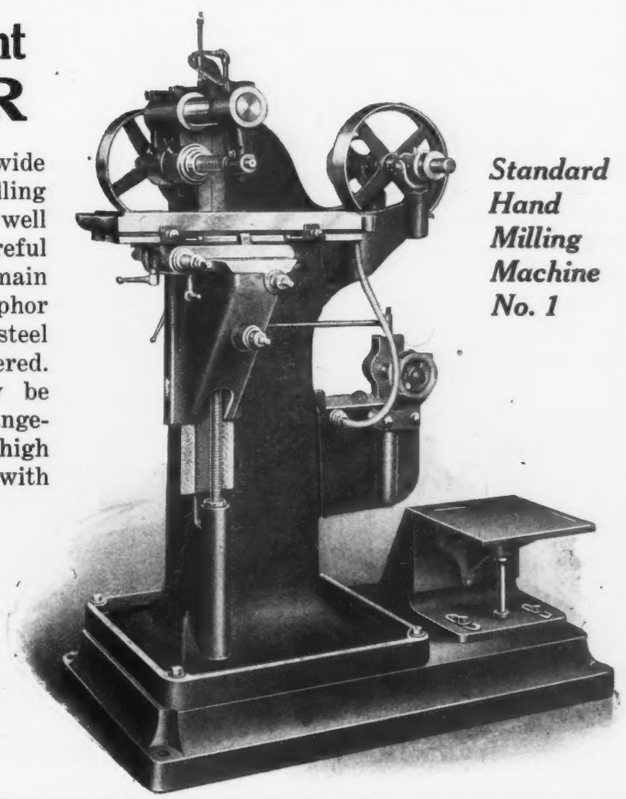
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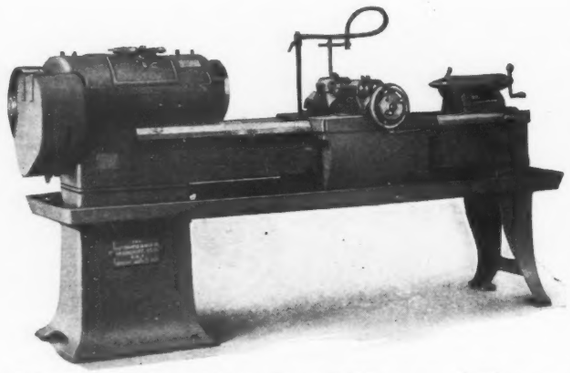
Designed to facilitate rapid milling on a wide variety of small parts, the Standard Hand Milling Machine has hand feed for the headstock as well as the table, and accuracy is assured by careful construction throughout; box type knee, main spindle bearing and adjustment nuts of phosphor bronze, 50 point carbon crucible analysis steel spindle—accurately ground to size and tapered. For further convenience the machine may be equipped with "Standard" Motor Drive arrangement, as illustrated—a sub-base, 5 inches high with bracket to carry the motor—provided with slots to accommodate motors of various makes and sizes and to facilitate proper alignment of motor and pulley.

Details of this versatile machine in catalog



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STANDARD ENGINEERING WORKS
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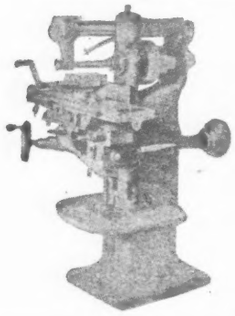


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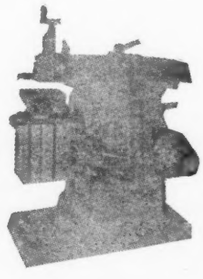
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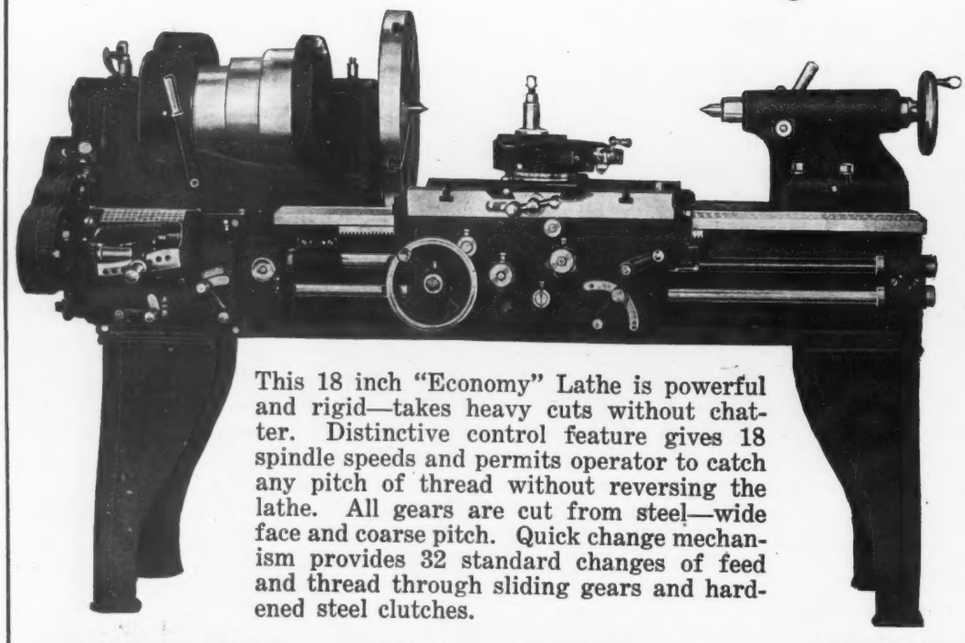
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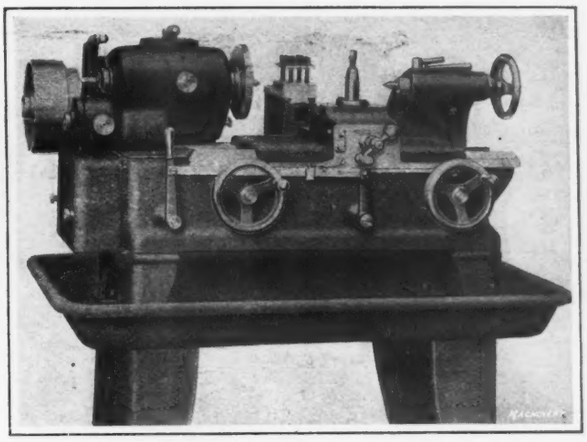
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A Nine-Inch Precision Lathe For Manufacturing Purposes

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The new nine inch "Sundstrand" is designed for this very purpose. Stockily built, it maintains uniform accuracy at high speeds, saves 50 per cent of floor space—without in any way sacrificing efficiency—and is so simple to operate that the shortage of skilled labor need not reduce production.



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ENGINE LATHES ARE SCARCE

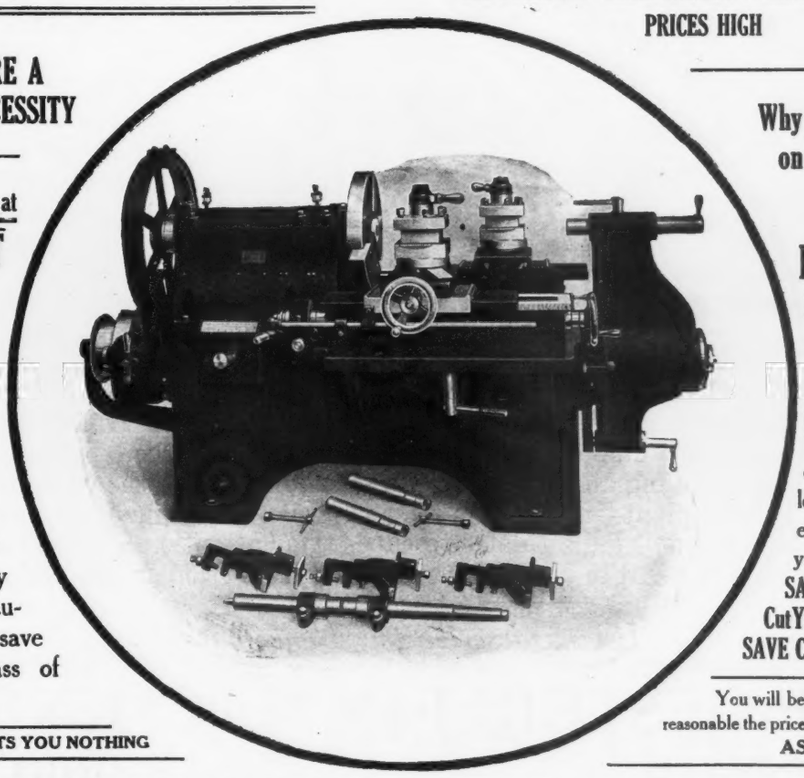
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You will be surprised to find how reasonable the prices of these machines are.
ASK US

THE CINCINNATI PULLEY MACHINERY CO., Cincinnati





Building the OHIO Miller—

The Spindle

If there is one part more important than another in building a milling machine, it is the spindle. It carries the taper into which the cutter arbor fits, takes all the thrust of cutting tools and bears the brunt of any abuse to which the machine may be subjected. Its bearings are the first to chatter, heat or sweat if not properly made and adjusted.

MILLERS
OHIO
GRINDERS

In the Ohio Miller, the spindle is extra large, forged of chrome nickel spindle steel, provided with ample means for taking up wear and runs in carefully fitted phosphor bronze bearings. An abundance of lubricant is available at all times, from oil wells in the column.

A recess in the front end of the "Ohio" spindle provides a positive drive for cutting arbors—a very important point which eliminates the possibility of tools slipping. Assembling and adjusting the spindle is always the work of specialists—in the "Ohio" plant—men whom long experience has made so familiar with every detail that no smallest defect escapes their attention. This specialized assembling puts the seal to your guarantee of satisfaction in the Ohio Miller.

Let us describe the whole machine.

THE OESTERLEIN MACHINE CO.

CINCINNATI OHIO, U. S. A.

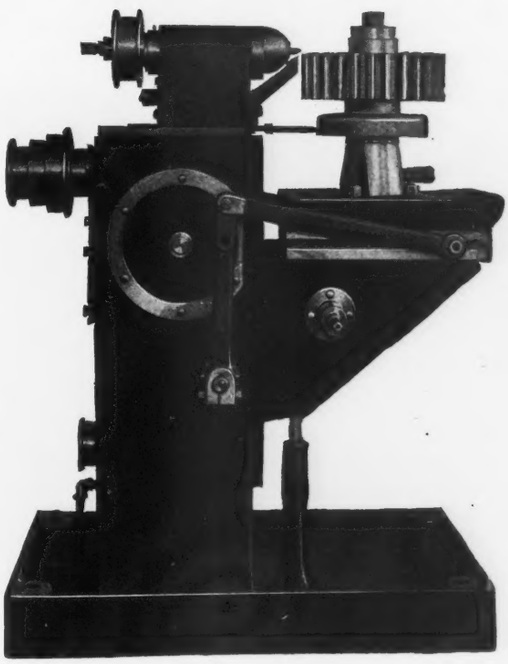
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The only machine that will successfully round tank and tractor gears *on a production basis.*

It is guaranteed to round 24 gear teeth a minute, of any pitch, 6—8 or finer. Every tooth is a perfect half round from tip to root.

Manufactured and sold exclusively by Cross Gear & Engine Co. from Cross Patents allowed and pending.



The Cross Gear Tooth Rounder is the original machine which allows the gear to be *held rigid* during the cutting operation, and where the cutter spindle *oscillates about an axis eccentric* to its own axis of revolution.

All other machines having this principle are direct infringements, and all manufacturers, sellers or purchasers of the same will be considered infringers and will be liable to the full extent of the law.

Do you wish details?

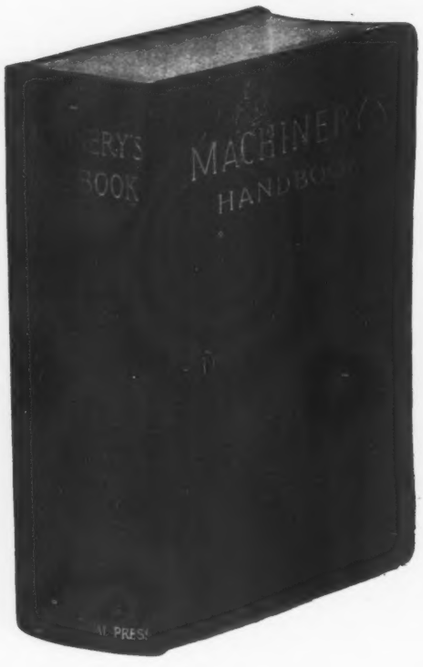
CROSS GEAR & ENGINE COMPANY

809 BELLEVUE AVENUE DETROIT, MICH.

MACHINERY'S Handbook

Not a big book if measured in cubic inches—but the biggest book in the mechanical field if measured either in *value* or in total sales. MACHINERY'S Handbook contains the whole mass of essential data, tables and formulas needed daily and hourly in machine shop and drafting-room —the facts and figures that are part of the equipment of the machinist, the machine designer, the foreman, superintendent and engineer.

No single advertisement can adequately describe MACHINERY'S Handbook, but some idea of the way in which innumerable subjects are handled in this comprehensive work may be gotten from the description of a single one of thousands. Take, for example, the section on:—



SPEEDS AND FEEDS

This section of MACHINERY'S Handbook contains the most complete collection of tables of cutting speeds and feeds for the various machine tools and the raw materials used that has ever been gathered together and published in any book.

Cutting speeds and feeds for the Lathe are fully covered, each being treated separately. Milling speeds and feeds are given in a remarkably clear and complete way, including not only descriptive paragraphs and very full tables, but also many specific examples of cuts from practice, with diagrams and full information in regard to material, depth of cut, etc., all arranged in tabular form. Drilling is adequately dealt with, both in regard to ordinary speeds and high speed work. Planing speeds and feeds are considered and a table of Actual Cutting Speeds of Planers is given. Gear Cutting is fully presented, and under this head Feeds for Hobbing are covered. Speeds and feeds for Cold Sawing receives adequate attention and there are paragraphs on Speeds for Turning Unusual Materials such as Slate, Rubber, Gutta Percha, Copper, Lime-stone and Marble. All of these data are based on the assumption of proper TOOL GRINDING which is given very clear treatment in the section of the HANDBOOK following the one on Speeds and Feeds.

The important subject of CUTTING LUBRICANTS is treated in the HANDBOOK in a separate section, lubricants for various operations and materials being discussed by competent, practical mechanics and engineers.

The whole book (1400 pages) is conveniently arranged and thoroughly indexed. It is easy to find what you want, and what you want is there.

Finely printed on carefully selected bible paper to keep the size convenient, and handsomely and durably bound in full flexible black leather, MACHINERY'S Handbook will give long, satisfying service.

Have You Got Your Copy?

"The Most Complete Collection of Practical Mechanical Data Ever Published."

☞LET US SEND YOU A COPY FOR EXAMINATION☜

Date.....

MACHINERY, 140-148 Lafayette Street, New York City.

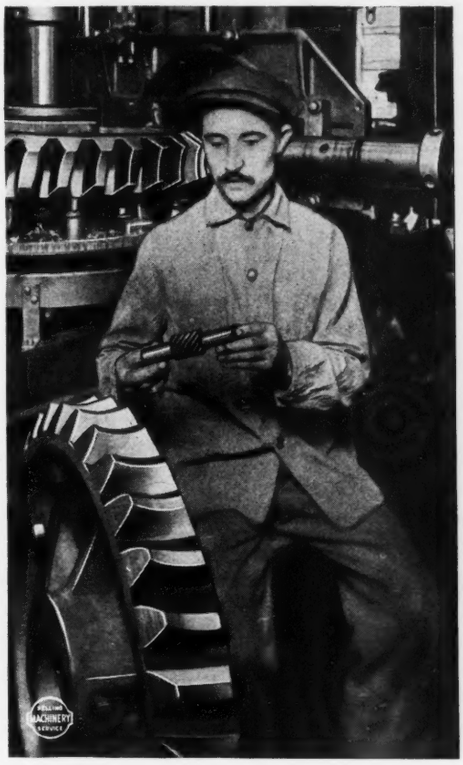
You may send me a copy of MACHINERY'S HANDBOOK for ten days' free examination. I enclose $2.00, and if I am not satisfied with the HANDBOOK, I have the privilege of returning it, and you will refund me the $2.00. If I keep the HANDBOOK, I will send you the balance, $3.00, at the rate of $1.50 a month.

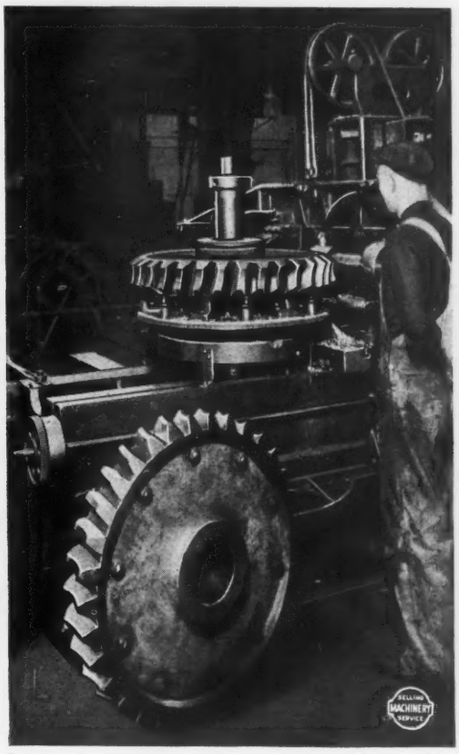
Name .....

Address .....City .....

Occupation .....Works .....

Newark Gear Cutting Machines





Newark Gear Cutting Machines if you use gears in quantities sufficient to keep them busy.

Newark Contract Service if you buy your gears in the market. Write for more details.

Some Things Some Shops Do Better Than Others

And one of the things we do well out here in Newark is to cut large worm gears. There is a continuous flow of them through our Gear Cutting Department—and the variety in size and materials is quite remarkable.

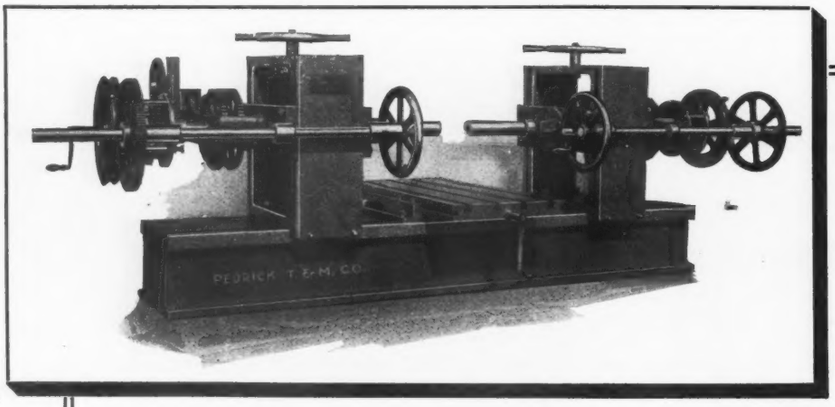
The large worm gears shown are part of a war machine for your Uncle Sam—more than this it is not wise to say. A shipment of them makes as fine a picture of top-notch gear manufacture as you ever saw.

Contract Gear Cutting

This end of our business is large and growing. Our equipment fortifies us against unusual demands—we don't believe you can spring anything on us that we can't handle with profit to all concerned.

Newark Gear Cutting Machine Company

NEWARK HENRY E. EBERHARDT, President NEW JERSEY



In Ordnance Plants

The Pedrick Duplex Horizontal Boring Machine is being used for turning trunnions, also for boring the bearings in gun carriages. The boring bars operate independently, but two of them are working at once on both trunnions or both bearings. Two sizes of the machine are made—3 inch or 6 inch bars, motor driven. *Circular?*

PEDRICK TOOL & MACHINE COMPANY
3639 N. LAWRENCE STREET PHILADELPHIA, PA., U. S. A.

Capacity up to ¼-inch

Details on Request



The Mason Bench Drill

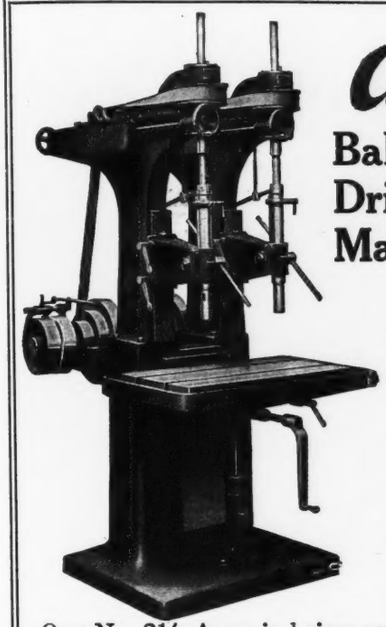
A High Speed Quick Change Machine That a Woman Can Operate

Capacity for high speeds is a strong feature of this machine; all moving parts are so well guarded that they, as well as the operator, are fully protected; a woman can duplicate a man's production records with perfect safety.

Mechanisms and controls are extremely simple and all parts are readily accessible to facilitate making adjustments. Changes of speed may be made without stopping the machine, and positive depth gage for spindle facilitates drilling to an exact point.

The "Mason" is equipped with ball bearings throughout.

ARTHUR C. MASON, Inc.
River and Putnam Streets
PATERSON NEW JERSEY



Avey

Ball-Bearing Drilling Machines

It is one thing to issue orders to your foreman to speed up work, but it is quite another thing to expect a speeding up without the aid of the right kind of a drilling machine.

Our No. 2½ Avey is being used in the largest plants for heavy duty work, and when orders are given to "speed up" the Avey does its share.

No. 2½ Avey—With 1 to 6 spindles, capacity 29/32" speeds up to 3500 r.p.m. Overhang 7½", 12", 15". Drills to center of 15", 24" and 30" circle.

The Cincinnati Pulley Machinery Co.
Cincinnati, Ohio

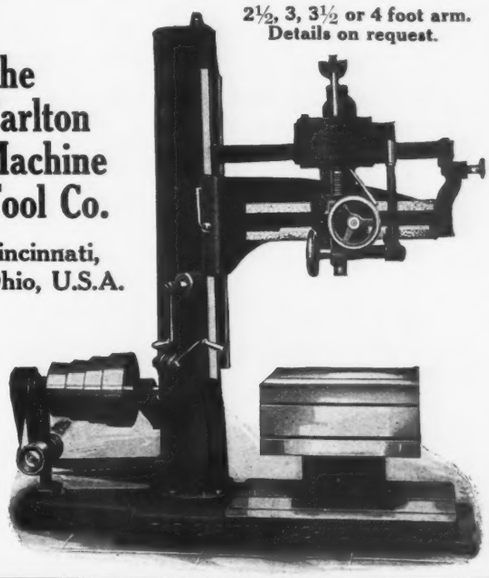
CARLTON RADIALS

No gears used in driving this speedy, high power radial—even the tapping attachment is belt driven.

High grade ball bearings take all radial and thrust loads, no running part rides upon a stationary one, friction is practically eliminated and alignments are readily maintained.

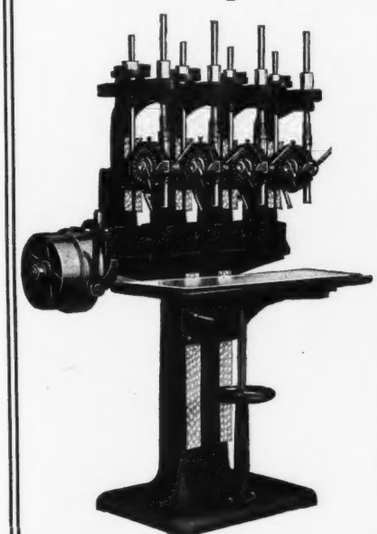
The "Carlton" has unusual strength and pulling power for its size and will drive one inch high speed drills to capacity.

2½, 3, 3½ or 4 foot arm. Details on request.



The Carlton Machine Tool Co.
Cincinnati, Ohio, U.S.A.

A Line of Drilling Machines That Help to Push Production



These Taylor & Fenn machines are made in five types and twenty-two sizes, covering practically every drilling need. Capacity up to ¾" drills; silent chain and positive gear drive. Particularly compact in construction and with the most improved features for accuracy and speed, these are production machines in every way.

Type C, as shown, has independent automatic power feed with quick return for each spindle.

The Taylor & Fenn Co.
Hartford, Connecticut

Manufacturers of Spring Foot Presses, Water Tool Grinders and Light High Speed Vertical Milling Machines



Silver's 20-inch Drills

Also Made in 2, 3 and 4-spindle Gangs

New patterns throughout, with an experience of 40 years behind them. Every detail carefully worked out. Materials the best procurable. Bevel gears accurately cut from solid blanks. Cog rack forged from steel and teeth milled to gauge. Four styles—plain lever feed, lever and wheel feed, power feed and automatic stop and with back gearing—round or square base.

Complete description on request—20" or 25" or both

The Silver Mfg. Co. 385 Broadway, **Salem, Ohio**

You Can't Make Something Out of Nothing

To make a good lathe not only requires brains, the best of material, the highest skilled workmanship, but also the closest possible attention to every little detail.

Accuracy is essential, and every part must be as accurate as any other part. Uniformity is necessary and every factor of each lathe must be uniformly correct. Weight must be equally divided, so as to insure rigidity in every feature, and a good lathe does not fall together. You have to nurse it, watch it, give it every attention.

Well, you know, we found all that out and today we are giving you

CISCO—The Lathe With the Pull
CISCO—The Lathe of Simplified Accuracy

Your neighbor, your competitor knows all about it. Do you?

Every Lathe is .0005 in 18" or Better

THE CINCINNATI IRON & STEEL COMPANY, CINCINNATI, U. S. A.

MAKERS OF 14", 16", 18", 24" ENGINE AND TOOL ROOM LATHES

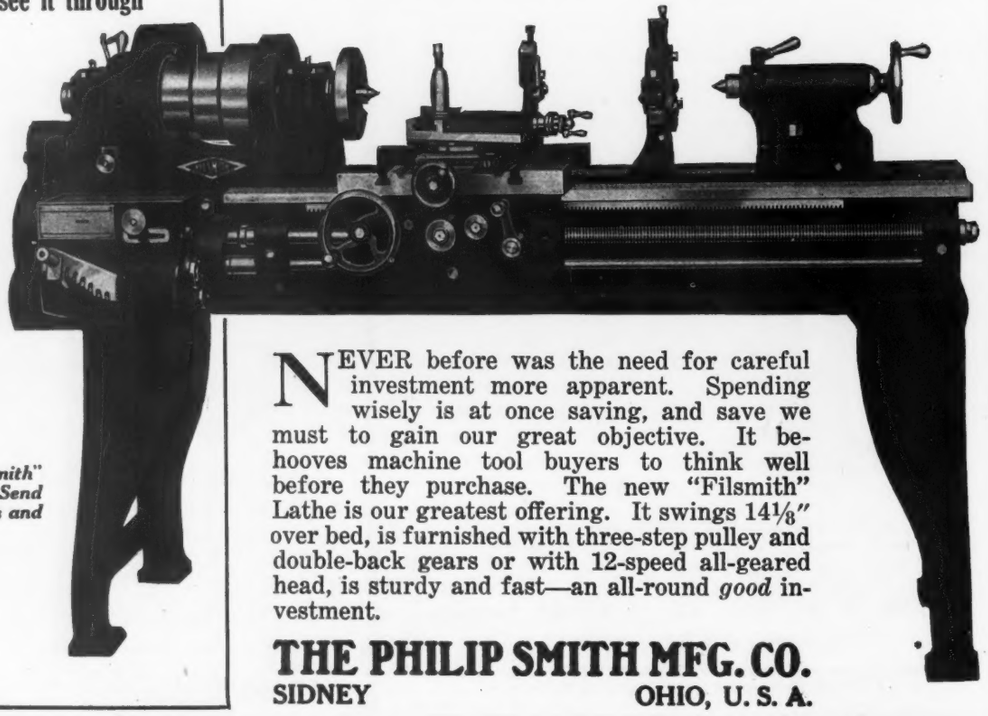
A. R. Williams Mchy. Co., Ltd., Winnipeg, St. Johns, Toronto, Montreal and Vancouver, Can. Hendrie & Bolthoff Mfg. & Supply Co., Denver, Colo. The Machine Tool Engineering Co., New York, N. Y. Knight & Wall Co., Tampa, Fla. McArdle, New Orleans, La. R. I. Scrutton & Co., Sydney, N. S. W. Perine Machinery Co., Seattle, Wash. Co-operative Machinery Co., Cleveland, O. Laughlin-Barney Mchy. Co., Pittsburgh, Pa. Southern Mchy. Exchange, Jacksonville, Fla. J. L. Lindsay, Richmond, Va. Stratton & Bragg Co., Petersburg, Va. Henry Walke Co., Norfolk, Va. Manufacturers Selling Agency, Birmingham, Ala. Cotton States Belting & Supply Co., Atlanta, Ga. Bernard E. Mohr, St. Louis, Mo. C. E. Faler Mchy. Co., Detroit, Mich. Sherritt & Stoer Co., Inc., Philadelphia, Pa. Purinton & Smith, Hartford, Conn. H. A. Smith Mchy. Co., Syracuse, N. Y. A. R. Williams Mchy. & Supply Co., Buffalo, N. Y. Herbert R. Lowe, Providence, R. I. Badger-Packard Mchy. Co., Milwaukee, Wis. Dale-Brewster Mchy. Co., Inc., Chicago. Thompson Tool & Supply Co., Indianapolis, Ind. Pacific Eng. & Equipment Co., Portland, Ore. T. F. Crowther & Co., Boston, Mass. John MacNab, Hyde, England. Grimaldi & Co., Genoa, Italy. A. J. Coccaro & Co. (New York) for France and Spain. Five Continents Corporation (New York) for China. Channel Chemical Co. (Chicago) for New Zealand, Tasmania, Java and Africa.

W. S. S.

Means "We've Started Something"
Save and see it through

"FILSMITH" LATHES

Sturdy and Fast—a Good Investment



Let the new "Filsmith" help you save. Send for all the details and see how.

NEVER before was the need for careful investment more apparent. Spending wisely is at once saving, and save we must to gain our great objective. It behooves machine tool buyers to think well before they purchase. The new "Filsmith" Lathe is our greatest offering. It swings 14⅛" over bed, is furnished with three-step pulley and double-back gears or with 12-speed all-geared head, is sturdy and fast—an all-round *good* investment.

THE PHILIP SMITH MFG. CO.

SIDNEY OHIO, U. S. A.

SOUTHWORTH

Ask Us About Deliveries on the

SOUTHWORTH TURRET SCREW MACHINE

Made in Two Sizes:

No. 2 —14" Swing, Capacity for Bar Work up to 1"

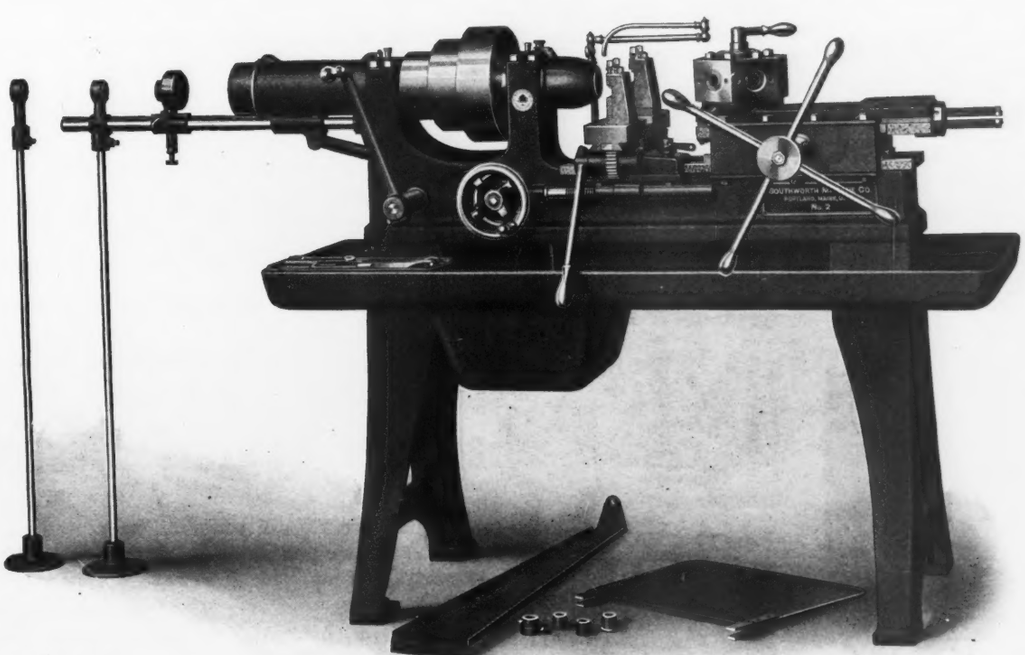
No. 4 —16" Swing, Capacity for Bar Work up to 1½"

THIS newcomer in the screw machine field is designed for rapid, accurate, profitable duplication of small parts for munitions and similar work, and is exactly what every manufacturer has been looking for. It won instant attention; repeat orders testify to that. It has made good its claim of excellence on every count.

In addition to a wide range of feeds and speeds, this machine can be equipped with power feed to turret slide; it has micrometer collar and adjustable stop. Turret has provision for six tools and simple and positive locking mechanism which insures rigidity and alignment.

If bar stock parts are not coming through quick enough in your shop, ask us about deliveries on this Turret Screw Machine.

Specifications in Bulletin



"First In Accuracy"

SOUTHWORTH MACHINE COMPANY

PORTLAND, MAINE, U. S. A.

This Gauge Tells You How Much

a part is out. With this information, many parts may be saved from the scrap heap.

Snap gauges will tell you only it is out, not how much it is out—yet a set of snap gauges costs a great deal more than the American Amplifying Gauge. Eliminate snap gauges—substitute the "American."

The American Amplifying Gauge handles all flat and cylindrical work within a wide range. It is quickly and easily operated and *can't be read wrong.*

Amplifying levers are housed in cross arm made of box section which provides a rigid dustproof casing.

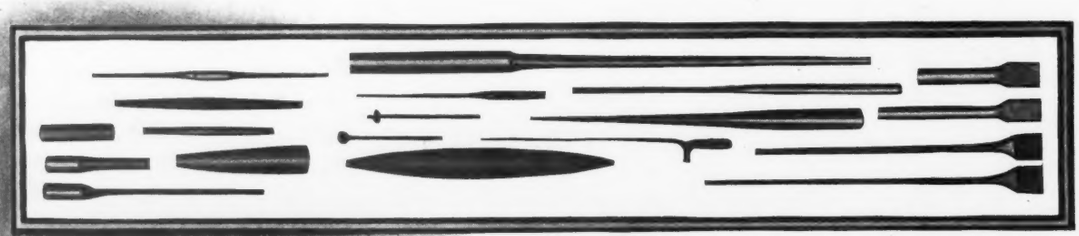
Large direct-reading dial graduated to 0.0001 inch insures speedy and certain operation

AMERICAN GAUGE COMPANY
P. O. Box 822 DAYTON, OHIO

AMERICAN
AMPLIFYING GAUGE



Improved "gauging end" permits measurements close up to shoulders, bosses, etc. Concentricity testing attachment and test centers for work up to 10" length by 4" diameter can be furnished. Further details upon request.





Save Time and Money, Conserve Metal and Improve Quality with

Langelier Swaging Machines

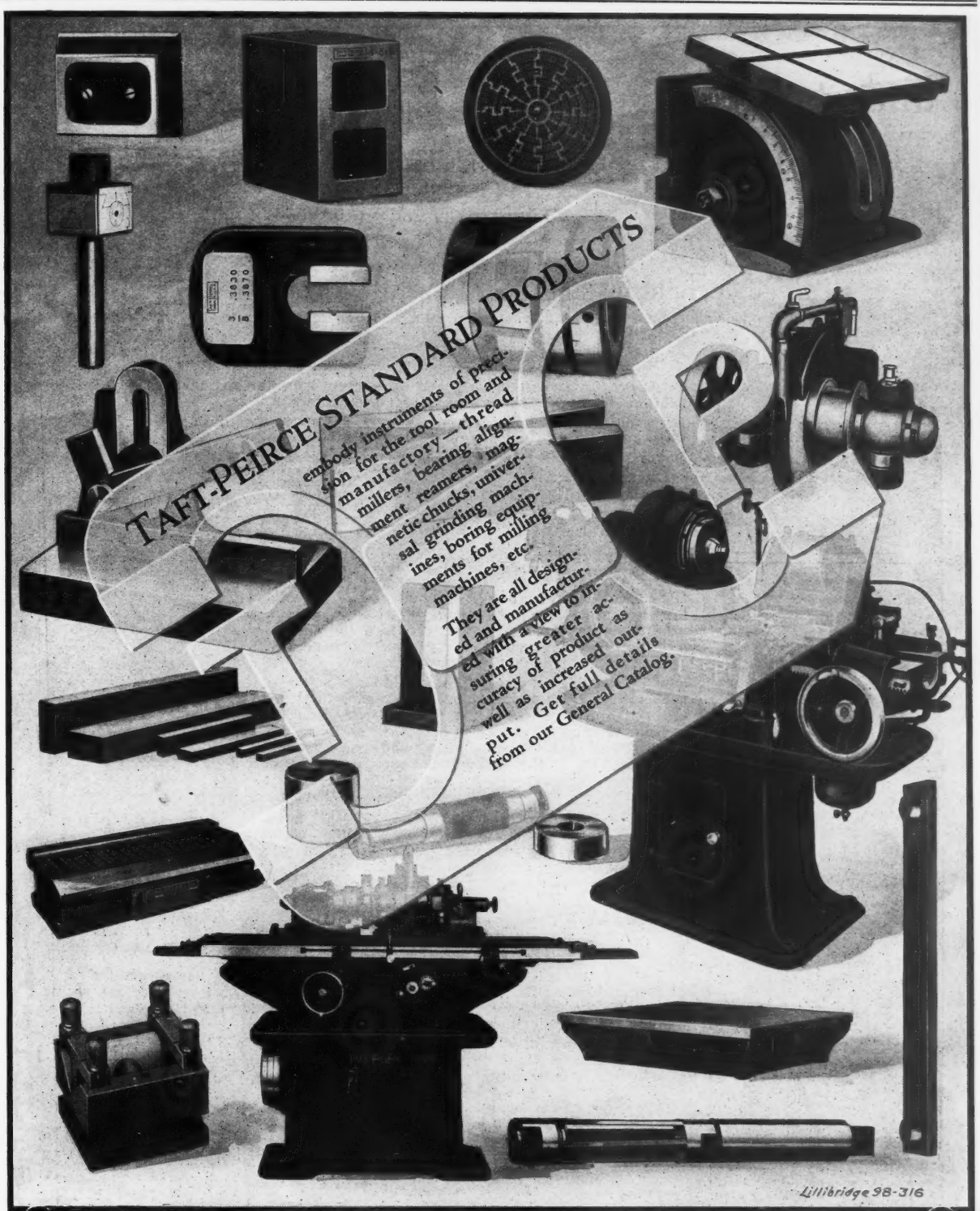
Langelier Swaging Machines shape solid or tubular stock to round, taper or irregular formed pieces of any desired size, quickly, accurately and economically, and produce a better surface finish than is obtainable by any other process.

They improve the metal; they eliminate waste. Much of the extremely hard metal now handled on trip hammers may be hot swaged on Langelier Machines with better results and at lower costs.

We also build a complete line of both revolving cage and stationary head roll type for reducing hot tungsten lamp wire.

Several sizes for immediate shipment from stock.
Send prints or samples at once for cost estimates.

LANGELIER MANUFACTURING CO.
PROVIDENCE, RHODE ISLAND, U. S. A.



TAFT-PEIRCE

Woonsocket, R.I., U.S.A.

New York Office, Woolworth Bldg. Detroit Office, Majestic Bldg.

Important for Draftsmen, Engineers, Inspectors, Toolmakers and Mechanical Executives

MACHINERY'S New Books on your special work are now ready for you

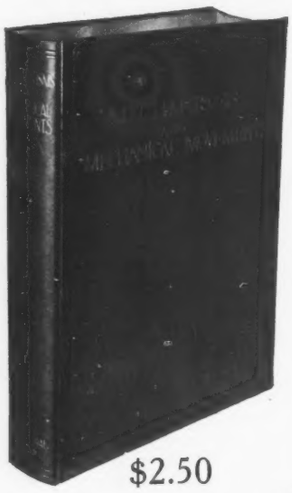
Bound in green cloth to match MACHINERY'S other books on shop practice

Mechanisms and Mechanical Movements

Hitherto every machine designer, mechanical engineer or inventor has had to rely on widely scattered sources of reference for data on mechanical movements.

MACHINERY'S new book, "Mechanisms and Mechanical Movements," deals authoritatively and practically with this highly important subject in machine designing. Today, as never before, the inventors of new mechanical devices, and the men who improve on present machines, tools and appliances, have their chance to sell their inventions to the highest priced market ever known.

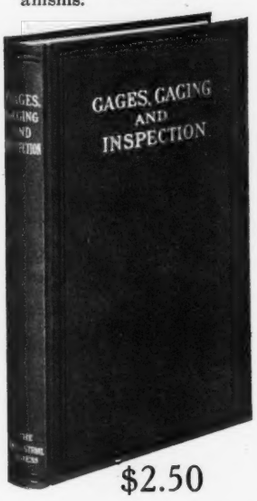
Every draftsman, every machine designer, and every man with a clever, inventive turn of mind needs a copy of this book.



$2.50

Motions and General Methods of Transmission in Machines.
Speed-Changing and Controlling Mechanisms.
Conversion of Rotary and Rectilinear Motions.
Reversing Mechanisms.
Quick-Return Motions.
Intermittent Movements.
Irregular Motions.
Differential Motions.
Clutches and Tripping Mechanisms.
Automatic Feeding Mechanisms.

Gages, Gaging and Inspection



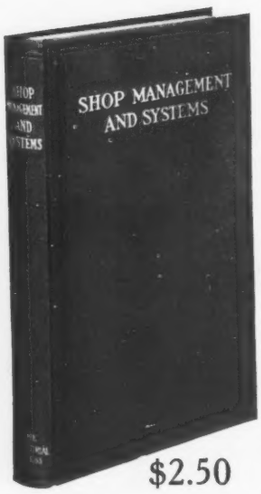
$2.50

High speed in production goes for nothing if the work is not accurate and the accuracy of the finished product depends on care in gaging. In fact, the development of interchangeable manufacture depends on gaging.

Men responsible for the millions of dollars worth of work in munitions manufacture have been waiting for this book. Not only should every inspector have one in order to know all about the design, construction and use of gages—but every toolmaker and machinist will find indispensable data and detailed explanations about every type of gage.

MACHINERY'S new book, "Gages, Gaging and Inspection," covers this field—explains every type of gage, shows its use and treats practically of the work of inspecting in all its branches.

Reference Standards and Measuring Machines.
Limits and Tolerances.
References, Working, and Inspection Gages.
Profile Gages.
Indicating Gages.
Gaging and Inspecting Screw Threads.
Gaging and Inspecting Gears.



$2.50

Shop Management and Systems

Shop Systems are as vital as plans of battles. No matter how small the shop may be, money and time can be saved by planning the progress of the work. The secret of success for the mechanical man is to apply these principles to his own plant, his own department, his own section, his own tool-room.

"Shop Management and Systems" puts clearly and practically before you the methods other plants have found to work well. The book is plainly written, mere theory is avoided and definite experience has been put into everyday, concise statements of facts. If you want to know how to be more successful as a manufacturer, superintendent or production engineer, if you are a foreman and want to put more snap and "go" and system into your department, read

Industrial Organization and Management.
General Shop Systems.
General Tool and Supply System for Large Plant.
Ordering, Manufacturing, Distributing, and Accounting System for Special Tools.
Following Progress of Work in Manufacturing Department.
Inspection System for Machine Shops.
Storage and Maintenance of Small Tools.
Tool Checking and Systems.
Methods of Delivering and Identifying Tools.
Tool Supply System under Scientific Management.
Tool Engineering Department.
Organization of an Assembling Department.
System of Purchasing Department.
Wage Systems.
Drafting-Room Systems.

Date.....

THE INDUSTRIAL PRESS,
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Gentlemen:—You may send me, all charges prepaid, the book or books marked with an (X). I agree to return them to you within 10 days or I will remit in full within 30 days of receipt of books. The price is to be $2.50 each unless all three are ordered, when a special price of $6.00 for all will be allowed.

( ) **"Shop Management and Systems."**
( ) **"Gages, Gaging and Inspection."**
( ) **"Mechanisms and Mechanical Movements."**

Name.....Occupation.....

Address.....Works.....

Nichrome Castings

This Cast Nichrome Lead Pot In Service Nearly 2 Years

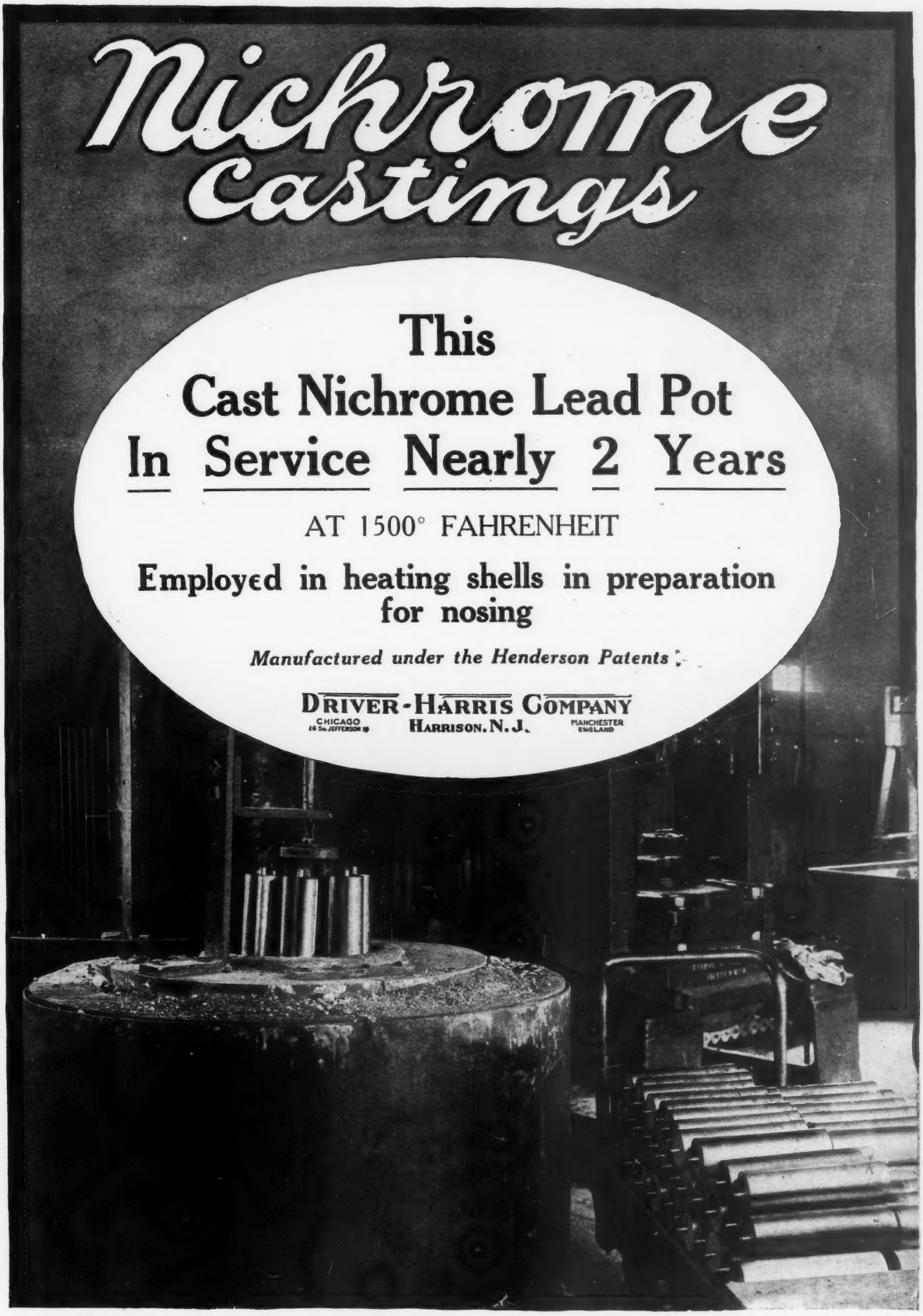
AT 1500° FAHRENHEIT

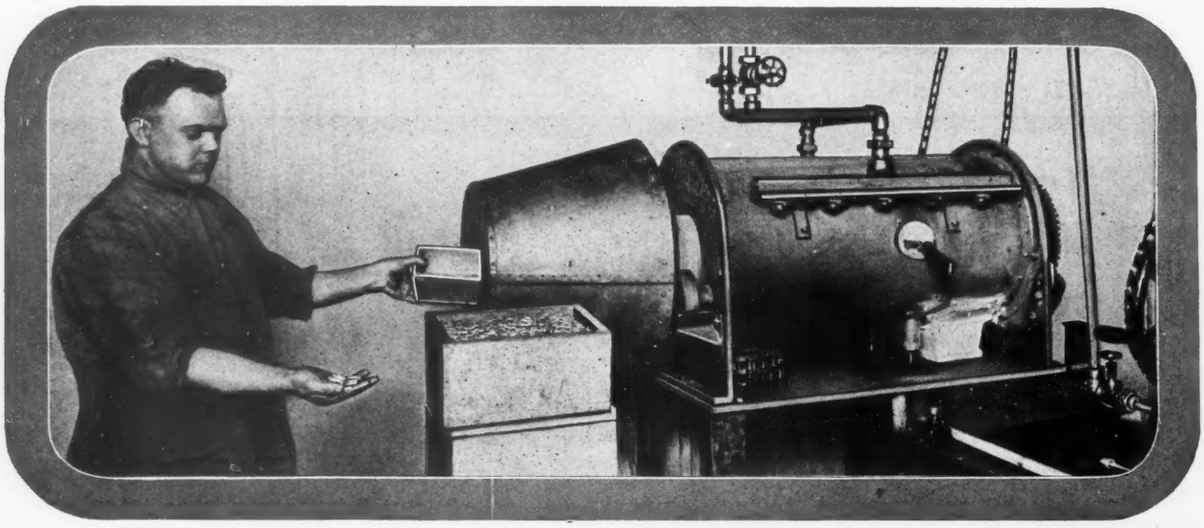
Employed in heating shells in preparation for nosing

Manufactured under the Henderson Patents

DRIVER-HARRIS COMPANY

CHICAGO 16 So. JEFFERSON ST. HARRISON, N. J. MANCHESTER ENGLAND





AN AMERICAN CONTINUOUS HEATING MACHINE

That is Giving a Good Account of Itself

This photo shows an American Continuous Heating Machine heat treating cylindrical tool steel parts—15/16″ long, 0.2″ diameter—on which uniform hardness throughout is required. Put through in lots of 150,000, the work is fed to the machine automatically through a hopper—and a half hour sees the first pieces ready for the oil bath—after which, output is continuous—6,600 pieces per hour—results guaranteed. This is SOME production, but American Gas Appliances are solving all manner of heat treating problems. Tell us yours—we can help you.

AMERICAN GAS FURNACE COMPANY, Engineers and Manufacturers, 24-26 John St., NEW YORK

FORGING SERVICE—

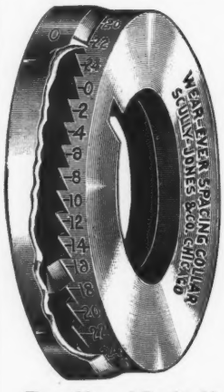
Means performance, and we are performing to the satisfaction of a great many of the largest machine tool builders in the country. We can do the same for you right now.

If you use spindles, gear blanks, shafts, rings - in fact any kind of hammered forgings — we would like to figure with you.

Today is a good day to drop your specifications and blue prints in the mail addressed to

The Steel Forgings Company

CINCINNATI OHIO, U. S. A.



Durable and Profitable Details on Request

LITTLE things make big differences in production costs—little time and trouble savers like the

WEAR-EVER Spacing Collar

make a surprising increase in the output of a big milling machine. This collar gives a total adjustment of .024″ by means of twelve .002″ steps.

SCULLY-JONES & CO.

647 Railway Exchange Bldg.

CHICAGO ILLINOIS, U. S. A.

Pressed Steel and Brass Grease Cups
Oil Hole Covers
Screw Top Oil Cups—Both Brass and Steel



Plain D Oil Cups

Send for Catalogues

Bowen Products Corporation

Successors to

The Winkley Company

866 W. Warren Avenue DETROIT, MICHIGAN

Metal Testing Instruments

For Hardness Tests

The Brinell Meter Complete Outfit $55

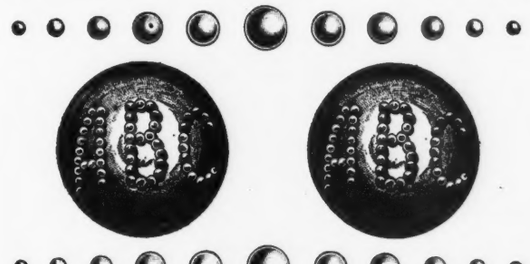
Many Hundreds in Use. Write for Booklet

Herman A. Holz

Apparatus for Metallurgical Testing and Research Work

Metropolitan Bldg. New York

STEEL BEARING BALLS



THE ABBOTT BALL CO.

Elmwood Hartford, Conn.



"YES! IT'S A GLASS HARD CASE AND PRODUCED WITH A NON-POISONOUS CHEMICAL"

FERRO CASE

For Case-Hardening

Something You Have Been Looking For

A non-poisonous chemical that is used by sprinkling upon the red-hot steel, or in a cyanide melting furnace, same as cyanide has formerly been used.

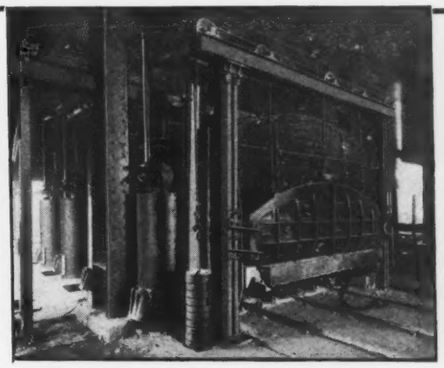
Our best argument is a trial.

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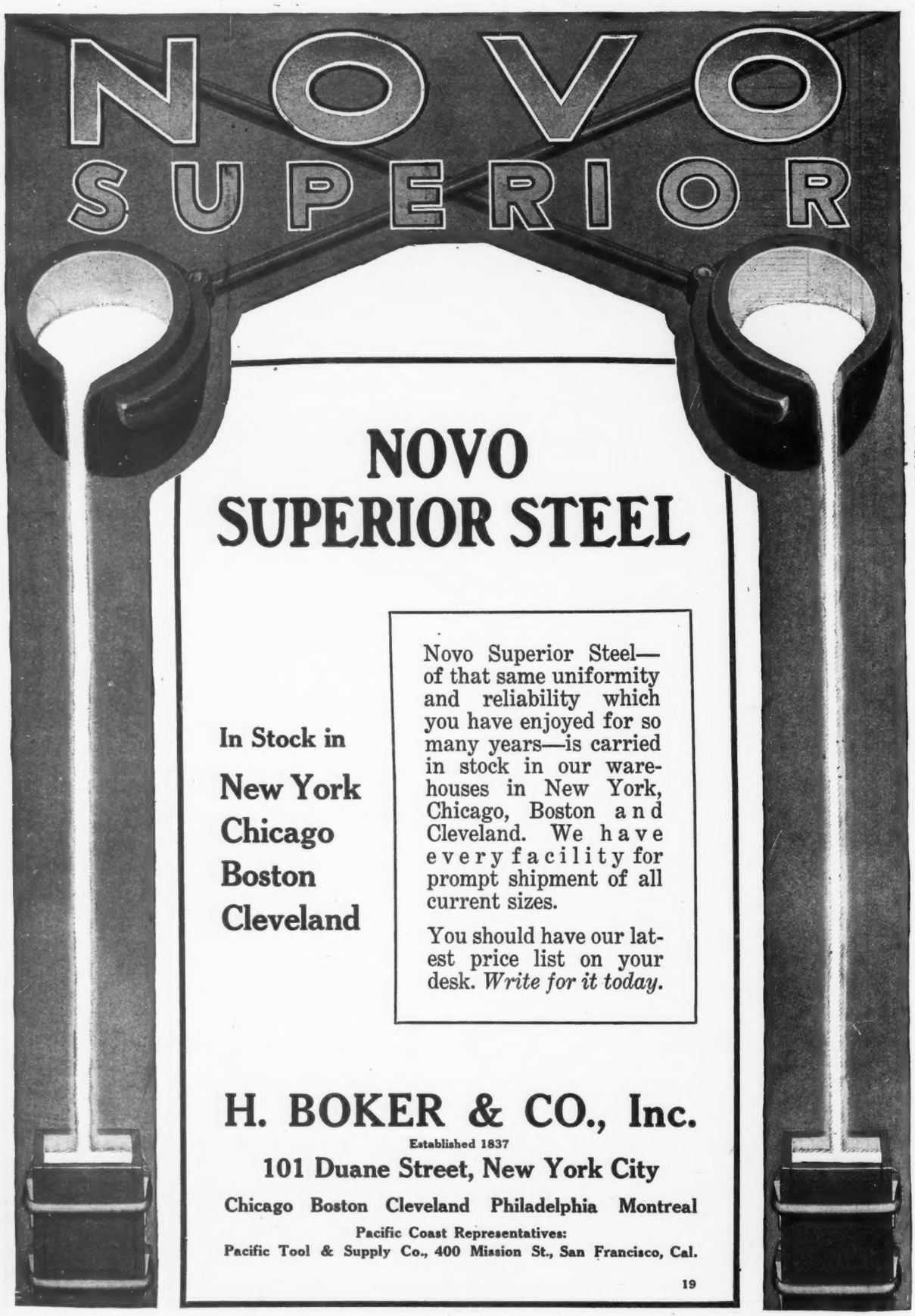
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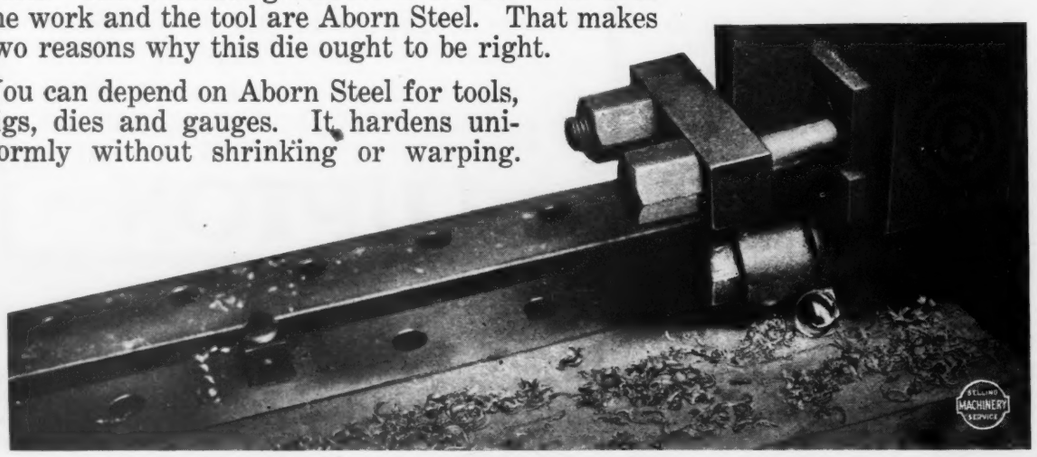
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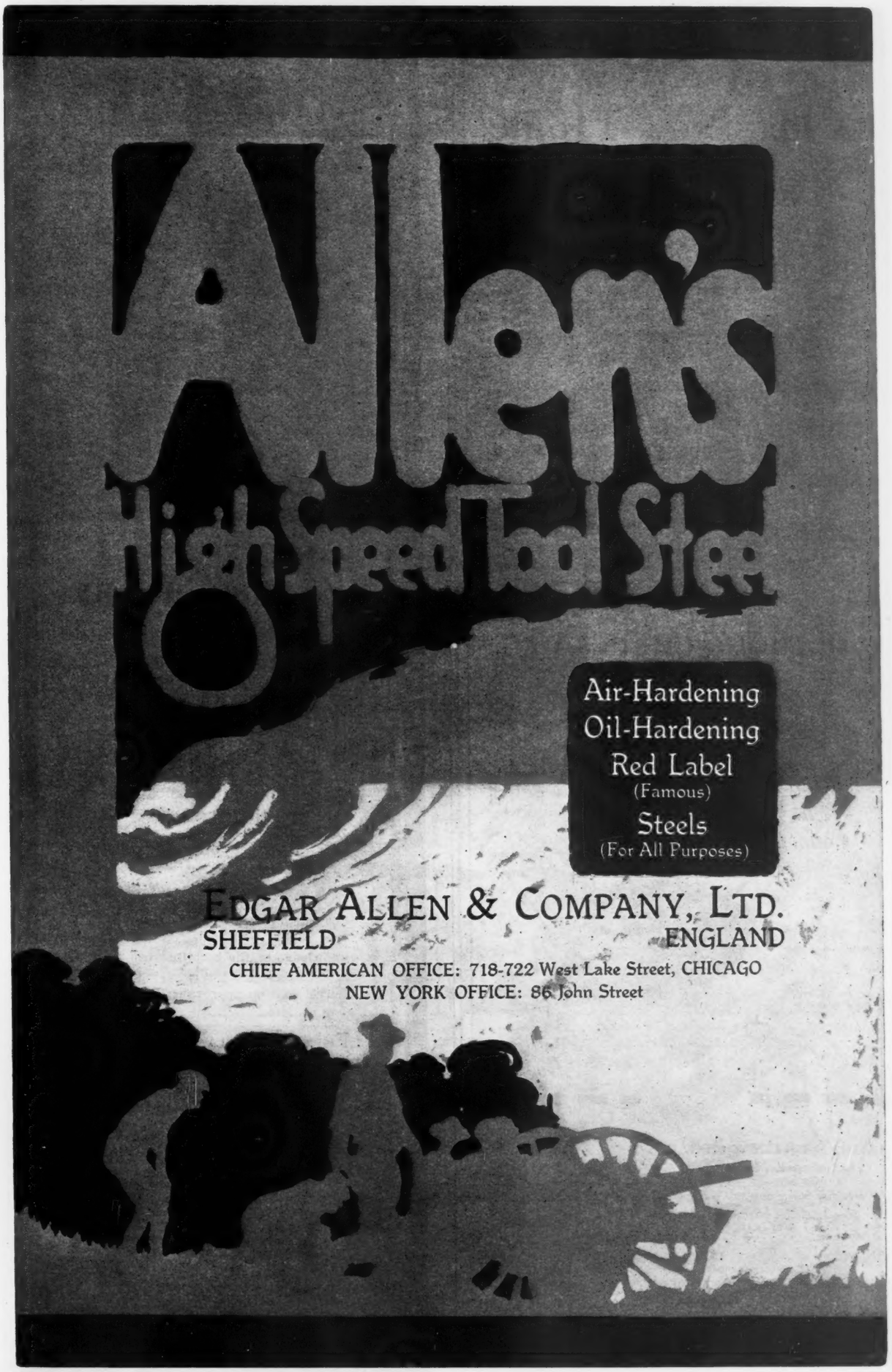
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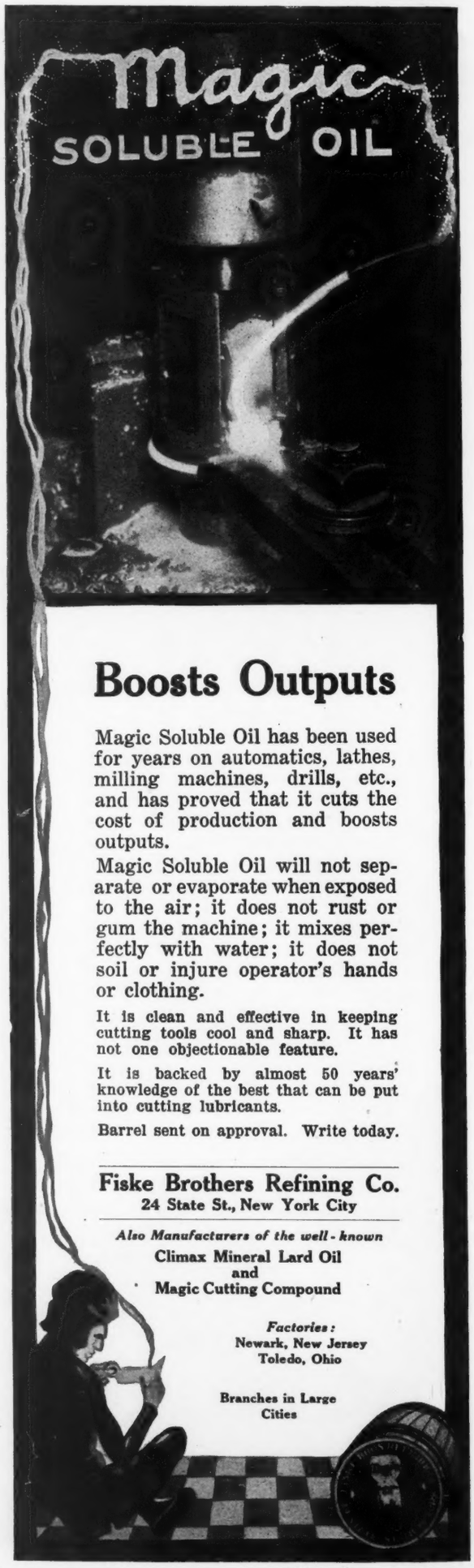
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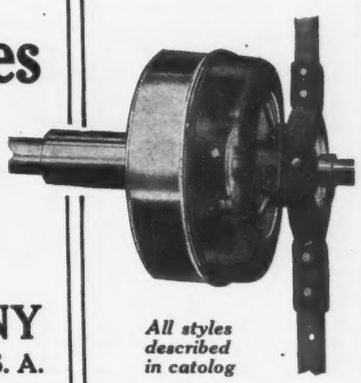
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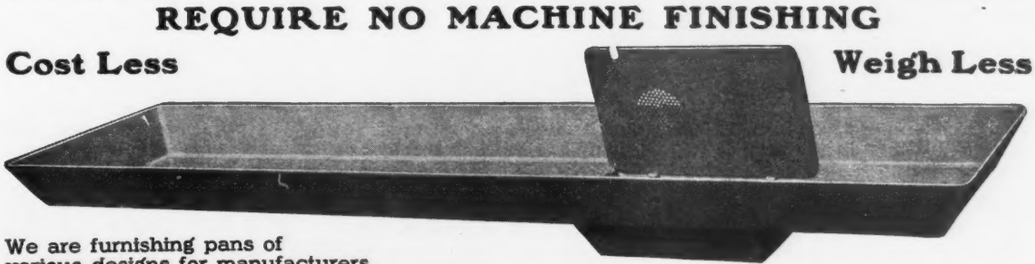
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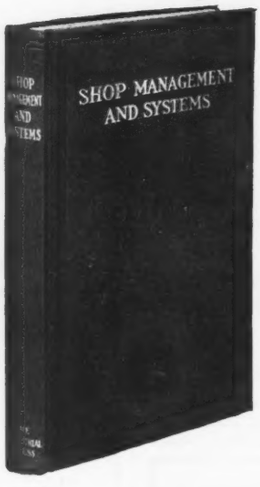
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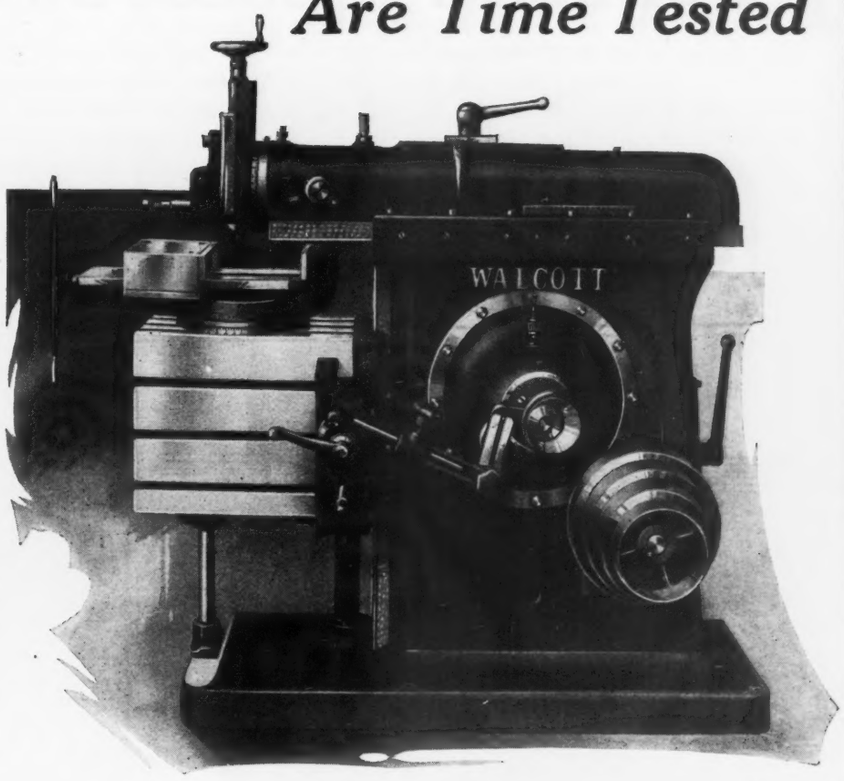
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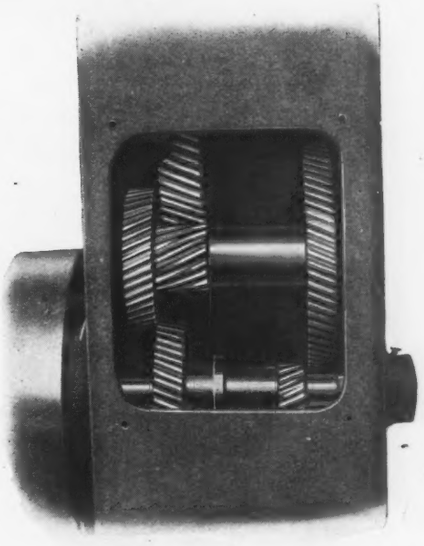
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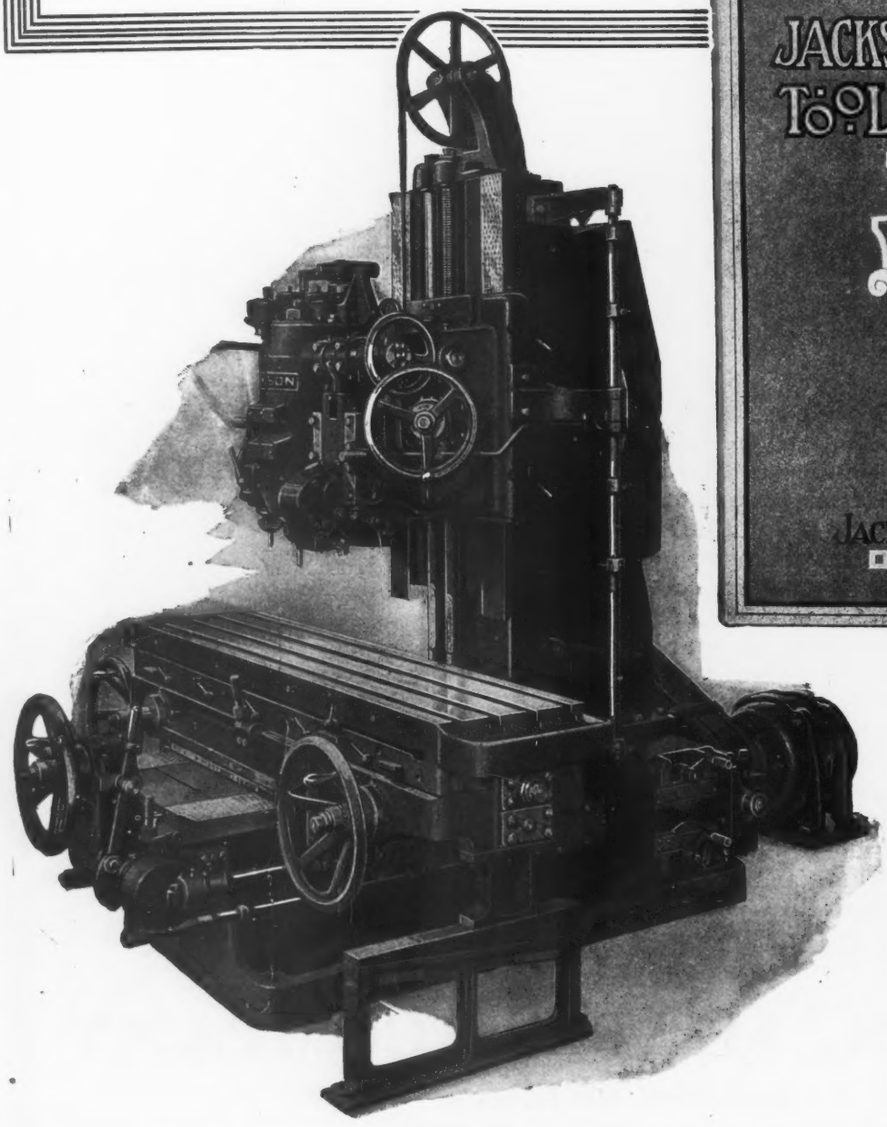
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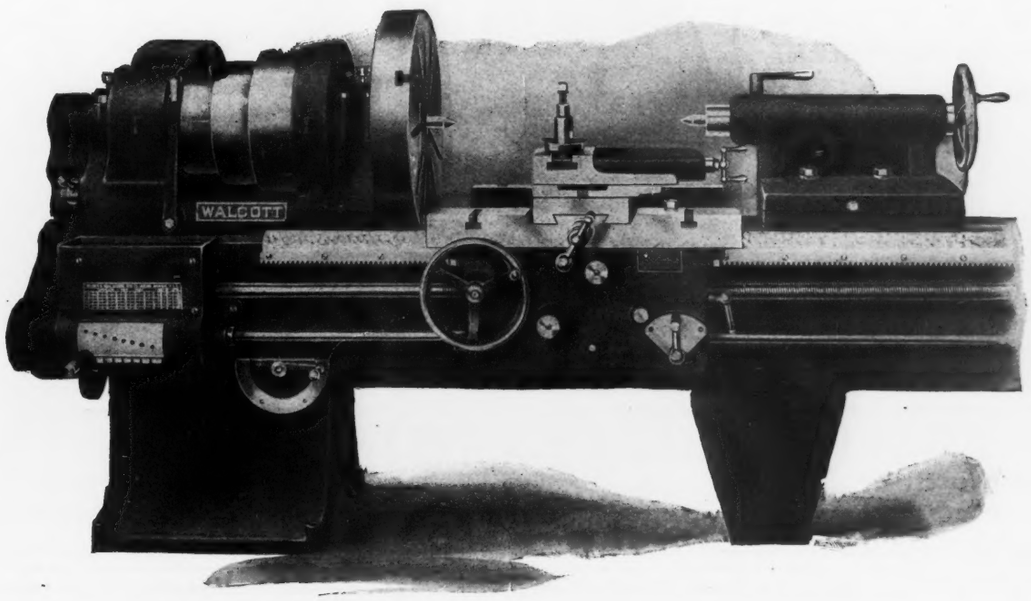




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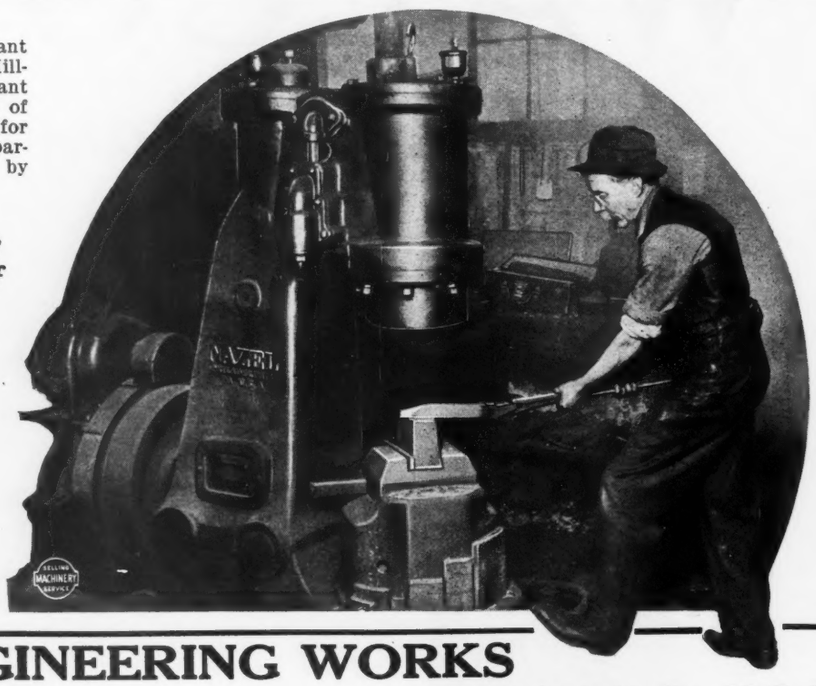
Hill, Clarke & Co., Chicago, Ill.; Frevert Machinery Co., New York City, N. Y.; W. E. Shipley Machinery Co., Philadelphia, Pa.; Motch & Merryweather Machinery Co., Cleveland, Ohio; Motch & Merryweather Machinery Co., Pittsburgh, Pa.; National Supply Co., Toledo, Ohio; Brown-McDonald Machinery Co., St. Louis, Mo.; Smith-Booth-Usher Co., Los Angeles, Cal.; P. H. Reardon, San Francisco, Cal.; H. A. Smith Machinery Co., Syracuse, N. Y.; W. E. Duff, York, Pa. and Jacksonville, Fla.; Fenwick Freres & Co., Paris, France; Buck & Hickman, London, England; Parke & Lacy Co., Sydney, N. S. W.; Standard Mchy. & Supplies, Ltd., Montreal.

NAZEL HAMMERS

The forging shop is an important department in the Ingersoll Milling Machine Company's big plant and this Nazel Hammer is one of their busiest tools—used mostly for forging hand tools and similar "particular" work and well liked by every man in the place.

Popular in the Smithy
Profitable for the Chief

A rapid worker, it requires few re-heats—hasn't had a minute's trouble or cost a cent for repairs in the whole two years it's been installed. A Nazel Hammer is fully self-contained. The little motor on the back of the machine generates air through the self-contained piston in the hammer cylinder as required. No tapping—high pressure steam line—no air container tank—no power wasted while the machine stands idle. Details? Lots of them. Where to?



NAZEL ENGINEERING WORKS
4043 North 5th Street **Philadelphia, Pa., U. S. A.**



Soon Pays for Itself

The OLIVER Sawing Filing and Lapping Machine

is a real machine tool—durably constructed and fully self contained—specially designed for die making, but adapted to much of the miscellaneous work put up to the modern tool room.

It saws close to the outline—leaving a proper angle of clearance, files accurately and laps to a fine, true finish; can be used to advantage by any good mechanic—leaving the skilled diemaker free to design and lay out work. The "Oliver" saves an average of 30 to 60 per cent on production costs and soon pays for itself. *Details in circular.*

OLIVER INSTRUMENT COMPANY
ADRIAN **MICHIGAN, U. S. A.**

Winterhoff 10½" Motor Driven High Speed Sensitive Bench Drills

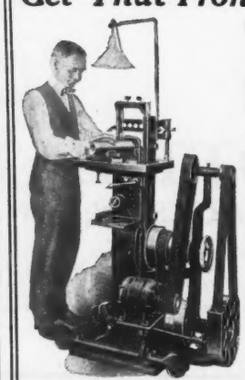
Belt or motor driven. Spindles have ball thrust bearings, are counterweighted and adjustable for wear and end play. Bronze bearings and ring oilers. Prices moderate. Send for details.



We can make prompt deliveries

WINTERHOFF TOOL & MACHINE CO.
Elkhart **Indiana**

Get That Iron Tool Maker Called



THE REARWIN Die Filing Machine

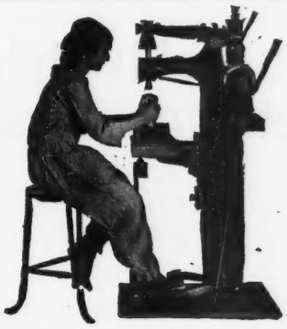
with 400 lbs. of filing efficiency to help you with your war orders on dies and tools. You can turn out more good work with less experienced help in less time than the old way with skilled toolmakers. Others are doing it, why not you?

The new catalogue and price list is interesting and yours for the asking.

W. D. REARWIN
341 Mill Ave., Grand Rapids, Mich.

THE HAMMER WITH THE HUMAN STROKE—

HEADS RIVETS COLD



Heads 'em tight or loose, flush, countersunk, or finishes heads any shape desired, and at the rate of:

A rivet a second, sizes up to 3/16"
A rivet in two seconds, size 1/4" to 3/8"
A rivet in three seconds, size 7/16" to 5/8"

and on special order we build machines to handle rivets up to 1½" with proportionate rapidity.

Built in eight sizes.

Besides riveting

The High Speed Riveting Hammer

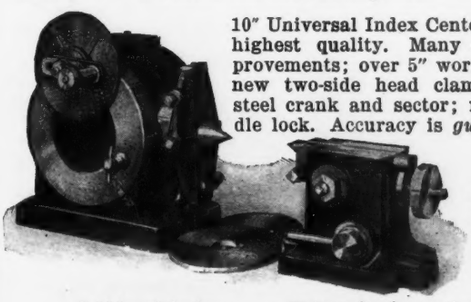
does all kinds of peening, swaging, upsetting, etc.

Send us sample assembly parts with rivets or sketch of your work and let us shoulder your riveting problems. Send for The High Speed Hammer Book.

The High Speed Hammer Co., Inc.

Rochester New York, U. S. A.

Can't Be Beaten on Accuracy and Delivery



10" Universal Index Centers of the highest quality. Many new improvements; over 5" worm wheel; new two-side head clamps; new steel crank and sector; new spindle lock. Accuracy is *guaranteed.*

Get the Original—Beware of Imitators

Sold by all dealers *Write today for particulars*

FRED C. DICKOW 35 SO. DESPLAINES ST. CHICAGO, ILL., U. S. A.

Trade SEMHI Mark

HUTHER SAWS

FOR CUTTING METAL

Write for catalog and full information

HUTHER BROS. SAW MFG. CO., INC.

1108 UNIVERSITY AVE. ROCHESTER, N. Y.



ELGIN PRECISION BENCH LATHE

Built to the highest standards of precision and accuracy. With their many attachments will be found adaptable to a wide range of uses.

Catalogue upon request

THE ELGIN TOOL WORKS

ELGIN ILLINOIS

See Where You're Going!

NO more working in the dark on your trimmer plates. No more machining "fairly close" to the impression line. Your work is in full sight when you use

The Billings & Spencer Improved TRIMMER MILLER

You can see where you're going with this perfected machine, cut clean to the line, and do your job like a good workman. The cutter is always in plain sight.

Here's another new point. No more trouble with chips. They can't get in the way of your work or come in contact with bearing surfaces.

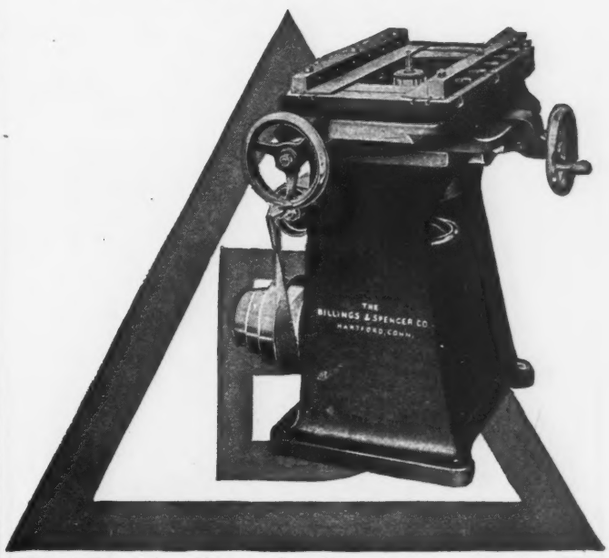
The efficient lubrication of the vertical spindle bearings is a feature.

We developed this machine first in our own shop under most rigorous tests and when it had made good for us we put it on the market for you.

It is peculiarly well adapted for milling the irregular outlines, and at the same time the necessary draft or clearance of trimming press dies, used for cutting the flash from drop forgings. Also adapted to milling cutting dies of all kinds for press work.

Write for specifications and literature

THE BILLINGS & SPENCER CO. HARTFORD, CONN. U.S.A.



RELY ON ME



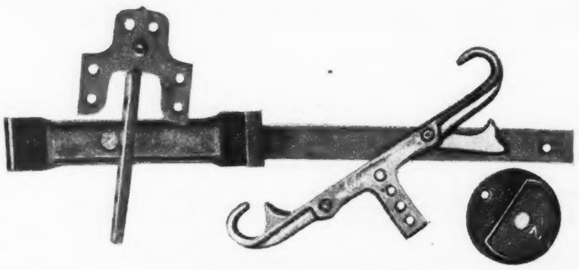
If you could watch the Grant Riveter on these parts—

"Zip"—another rivet set with a Grant Riveter! The blow is so quick and decisive, you scarcely realize it has fallen. Production is limited only by the operator's dexterity in feeding the work to the spindle—"GRANT" speed must be seen to be appreciated.

Grant Riveters are well constructed production tools—design, material and workmanship being adapted to hard service in both standard and noiseless "spinner" type machines.

Adjustment in these machines is quickly made for different heads and sizes, and "Grant" production records have set new standards in assembling departments all over the country.

How About Yours?



The Grant Mfg. & Machine Co.

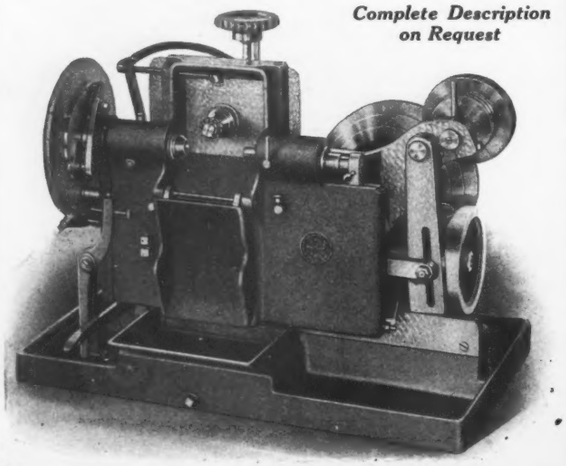
N. W. Station

Bridgeport Connecticut, U. S. A.

THE WALTHAM 4" GEAR CUTTER

Distinctive features for increasing output and securing close accuracy in cutting small gears and fine pitch pinions have been developed in this automatic production machine. For example—the cutter slide, when in position for cutting, is tightly clamped while the cut is in progress but is released during the return stroke so the slide may be lifted for indexing.

Complete Description on Request



Waltham Machine Works

Newton Street, Waltham, Mass.

Small Thread Millers, Gear Cutters, and other small Automatic Machines



IF you are interested in Rivet and Screw Machinery there is valuable information for you in this new catalogue. There is 60 years' manufacturing experience back of the Cook line of machines — experience that may help you.

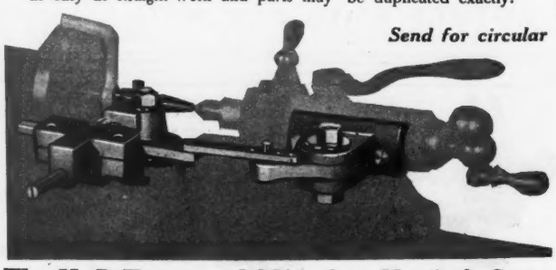
Let us send the book today

THE ASA S. COOK CO., Hartford, Conn.

The Townsend Taper Attachment

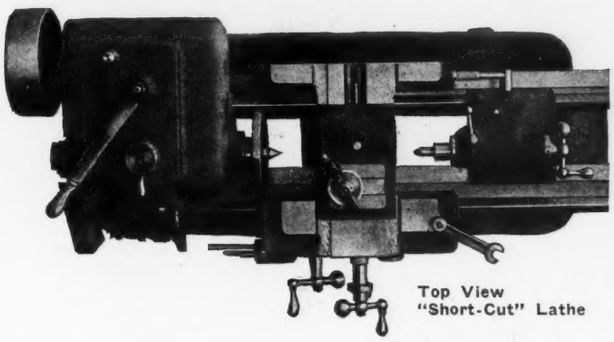
Is adapted for the rapid manufacture of tapers, reamers, twist drills, end mills, arbors, punches, etc, in quantities. Turning becomes as easy as straight work and parts may be duplicated exactly.

Send for circular



The H. P. Townsend Mfg. Co., Hartford, Conn.

READY!—
The Adams "SHORT-CUT" Lathe



Top View
"Short-Cut" Lathe

HOW much of your lathe work consists of short length pieces of medium diameter? Do you employ a standard sized lathe providing greater swing and longer bed than are necessary, with consequent excess costs? Or do you use a small lathe with the handicap of insufficient power?

We've designed a new lathe to handle this class of work most advantageously.

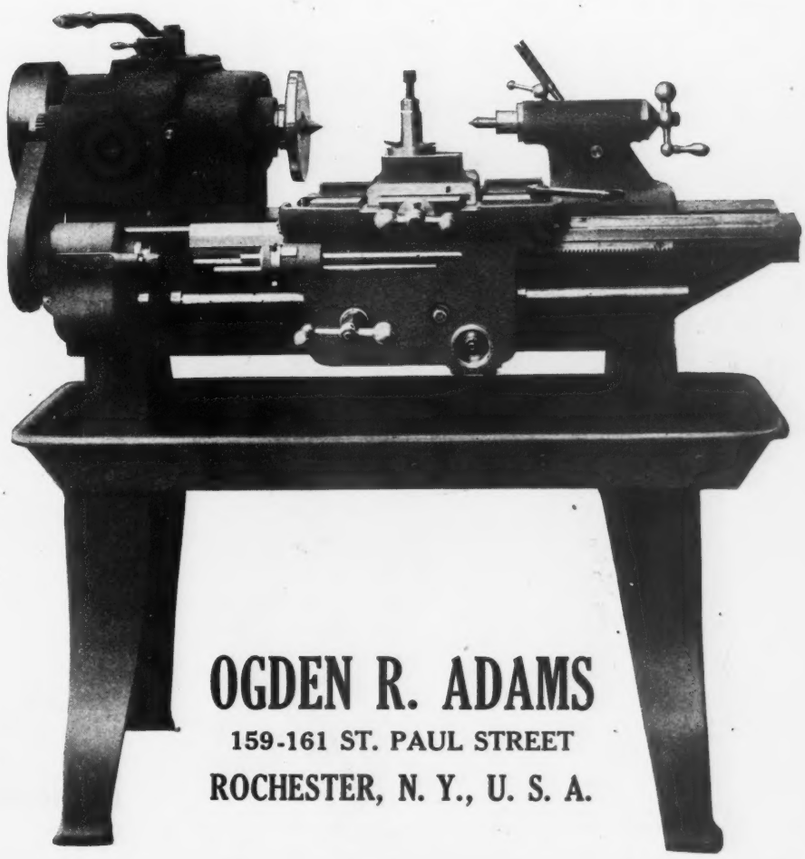
The Adams "Short-Cut" Lathe performs equally well for roughing and in extremely accurate finishing, costs less than larger tools, conserves fuel and labor, and shows many "short-cuts" from raw stock to finished pieces. It is exceptionally well built.

Geared head provides six speed changes through one operating lever and a sliding clutch. Headstock gears run in an oil bath, insuring perfect lubrication and a long life. Spindle is of crucible steel scraped to perfect bearing fit with hole capacity for 1" bar stock. Three positive feeds from 0.007 to 0.020 are instantly obtainable; three others with a two gear change.

DIMENSIONS

Swing over bed—12½".
Space between centers—19".
Length of bed—48".
Width of belt—2".
Dia. hole in spindle—1 1/16".
Max. cap. wire chuck—⅝".
Length of carriage—18½".
Width of cross-slide—7¼".
Spindle speeds (pulley running at 200 r.p.m.)—23 to 374 r.p.m.
Weight—1350 pounds.

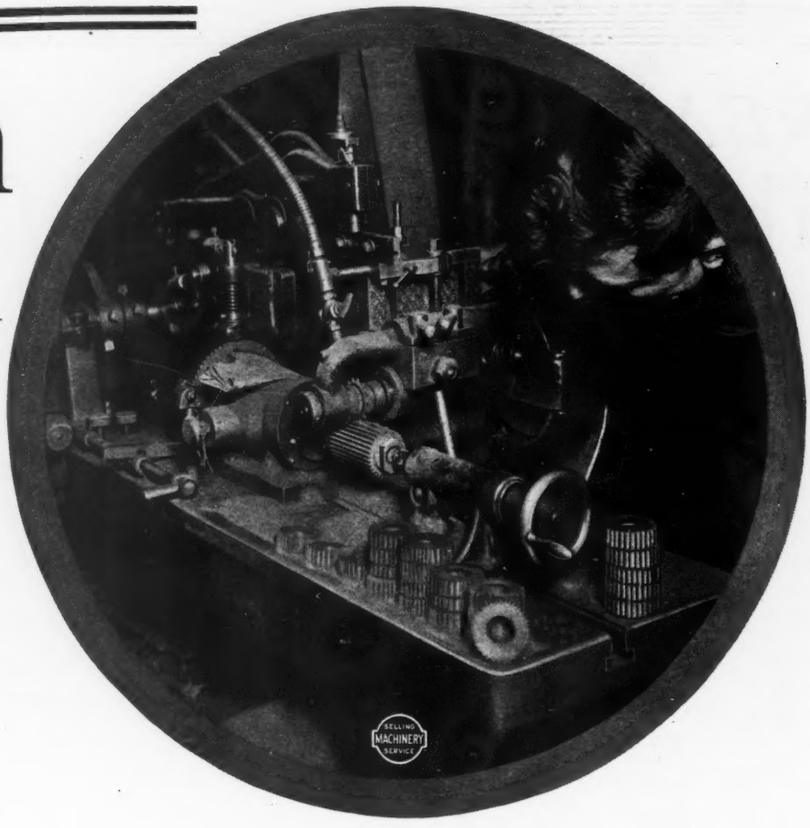
Write for further information and advice on deliveries.



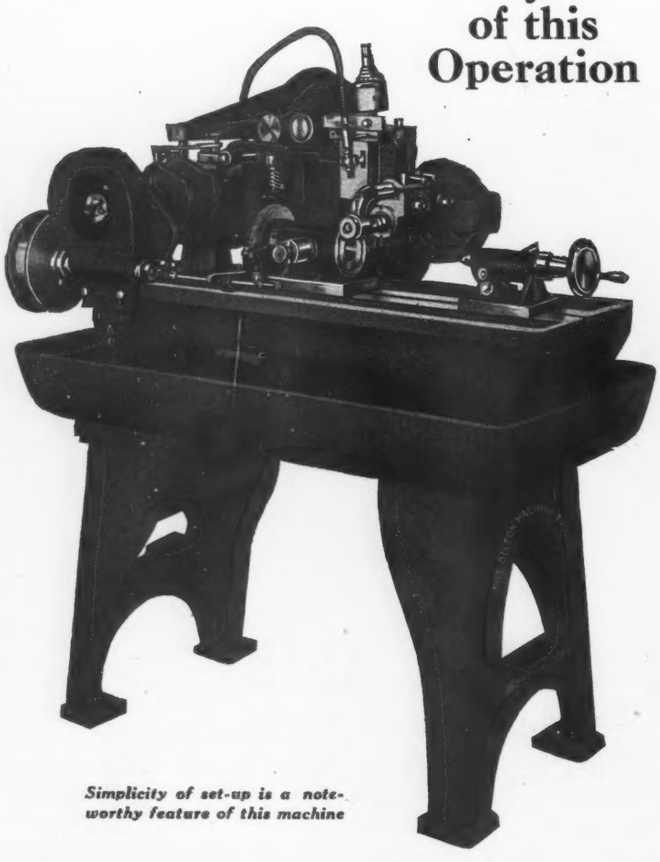
OGDEN R. ADAMS
159-161 ST. PAUL STREET
ROCHESTER, N. Y., U. S. A.

Bilton
Cut Gears
For Washing Machines

The accompanying photograph was secured at a Pittsburgh plant where washing machines are made. For nearly two years two Bilton Gear Millers have helped save labor in the manufacture of these labor-saving machines. They have also saved time and money. Take this illustration for an example of true economy.



Economy is the Object of this Operation



Simplicity of set-up is a noteworthy feature of this machine

The Bilton Gear Miller is machining 32 teeth, 16 pitch, on gears of 5/8" face. Five gears are mounted on the arbor at one time, and it takes just 25 seconds for the cutter to make one cut through the lot. One gang of blanks will be cut in 8 minutes, which makes a production of 38 gears per hour.

One operator tends both Bilton machines and three other tools besides.

Catalog No. 20M gives the reasons for Bilton supremacy. Send for it to-day and be convinced.

The Bilton Machine Tool Co.

BRIDGEPORT CONNECTICUT

FOREIGN AGENTS: Chas. Churchill & Co., M. Mett Engineering Co., Alfred Herbert, Ltd.

MACHINERY'S GREEN SECTION

Comprising the latest lists of Second-hand and Rebuilt metal-working machines, tools and accessories, now available. The merchants represented in the GREEN SECTION are well known to

MACHINERY



The GREEN SECTION is MACHINERY'S Second-hand Tool Department. Use it for Used Machinery.

MACHINERY

140-148 Lafayette Street, New York City

More Tools Wanted

Can you help on this?

MACHINERY is indebted to readers and advertisers for the quick response to our appeal made here last month for a number of tools that were badly wanted. Nothing could more effectively demonstrate the extraordinary circulation and the close attention the GREEN SECTION receives. The answers began to start as soon as the first copies of July MACHINERY were delivered and they came in all through the month; and they came from all over the country. The GREEN SECTION has arrived.

TOOLS WANTED

Cutting off machine of the Williams or Vandervoort type to handle 9.2″ and 9.5″ shell forgings. Immediate delivery necessary.

Power Punch and Shear 24″ to 36″ throat. Capacity about 1″ x 1″.

50,000 pounds used testing machine. Machine to be complete and in first class condition.

Small shaper—second hand, but in good condition.

3 ft. Sensitive Radial Drill.

MACHINERY'S GREEN SECTION

140-148 Lafayette Street, New York City

The Bread That Was Cast Upon The Waters

Truly it has been found after many days! How wonderful to imagine the ardent, liberty-loving spirit of Lafayette, who fought so bravely and devotedly for American liberty, gazing now upon the eager lads going forward with the stars and stripes and the tri-color to save and secure forever the liberty of his immortal France. These are the children of that freedom he fought for and the soldiers of freedom always win at last!

"For freedom's battle, once begun,
Bequeath'd by bleeding sire to son,
Though baffled oft, is ever won."



USED MACHINERY

DRILLS

One-spindle 24" Henry & Wright.
One-spindle 30" Henry & Wright.
Two-spindle Fox Sensitive.
Four-spindle Slate Sensitive.
5½' Baush post radial.
2-spindle Moline Cylinder Borer.
3—10" Barnes friction.
23" Barnes sliding head.
2—25" Blaisdell sliding head, back gears, power feed, auto. stop, new table.
No. 0 2-spindle Garvin Horizontal.
4-spindle 14" Foote-Burt power feed.
48" Dreses cone driven radial.
No. 2½—2-spindle Avey.
Two No. 2½—4-spindle Avey, with automatic feed.

GRINDERS

12 x 60 Landis Universal.
6 x 48 Pratt & Whitney Plain.
18—30 x 96 Norton Plain.
5—10 x 36 Nortons.
No. 60 Heald Cylinder.
No. 6 Bryant Internal.
20" Whitney Water Tool.
⅝" Yankee Twist Drill.
No. 4 Van Norman internal.
48 x 6 Springfield Double Head Planer Type.
No. 2 Walker, with outfit "J" gear cutter grinding attachment and center rest and 6" 4 jaw chuck.
No. 70 Heald internal with Type "F" wheel head.
No. 12—26" Besly disc grinder.

LATHES

10 x 4 Davis, C.R., P.C.F.
11 x 4 Mann R. & F.
14 x 8 Flather, C.R., P.C.F. Chuck.
18 x 10 Schumacher & Boye, C.R., P.C.F. Chuck.
44 x 16 Niles, C.R., P.C.F.
56 x 24 Wood & Light, C.R., P.C.F.
84 x 30 Putnam Plain Turning.
16 x 6 Automatic Threading.
3—16 x 6 Hendey geared head, 4 way tool blocks.
20 x 12 Hendey Norton screw cutting.
20 x 12 Fifield comp. rest power cross feed.
20 x 12 Putnam Pl.R., P.C.F. solid spindle.
28 x 14 L. W. Pond C.R.
21 x 8 Lodge & Davis C.R., P.C.F.

MILLERS

Nos. 1 and 2 Pratt & Whitney Hand.
F. E. Reed Lincoln Type.
No. 2 Owen, plain.
No. 3 Van Norman Duplex.
No. 9 Garvin Lincoln.
No. 2 Milwaukee back gears vert. and rack cutting att.
No. 32 Kempsmith Lincoln.
No. 0 Steptoe plain driving head and tailstock.

TURRET LATHES AND SCREW MACHINES

No. 2½ P. & W.
24" Gisholt, 6¼" hole.
2 x 24 Jones & Lamson Flat Turret.
No. 1, ⅝" Pratt & Whitney Wire Feed.
20" x 7' Fay & Scott Universal Turret.
24" x 10' Lodge & Davis Heavy Turret.
2" Garvin.
18 x 6 American.

PLANERS

20 x 20 x 4 Pease, one head.
26 x 26 x 6 Lodge & Davis, one head.
25 x 25 x 10 Sellers, one head.
36 x 36 x 14 Lodge & Davis, one head.

AUTOMATIC SCREW MACHINES

½" 4-spindle National Acme.
1⅜" 4-spindle National Acme.
1¼" Style B Cleveland.
2" Style A Cleveland.
4¼" Style A Cleveland.
3¼" Gridley Single Spindle.

MISCELLANEOUS

2—26 x 10 Automatic Gear Cutters.
No. 1 Slate Automatic Pinion Gear Cutter.
No. 2 36" Whiton Automatic Spur Gear Cutter.
150-lb. Plain Drop Hammer.
50-lb. Beaudry Power Hammer.
675-lb. Pratt & Whitney Board Drop Hammer.
6" Hurlbut & Rogers Cutting-off Machine.
7 No. 2 Stiles Power Punch Presses.
36" Stoll Power Squaring Shear.
No. 15 Lea-Simplex Cold Saw.
18" Newton Cold Saw with facing head.
No. 6 Fellows Gear Shaper.
No. 13 P. & W. Profiler.
No. 14 Cochrane-Bly Die Slotter.

HENRY PRENTISS & COMPANY, Inc.

Formerly PRENTISS TOOL & SUPPLY CO.

Singer Building, 149 Broadway NEW YORK

BOSTON, MASS BUFFALO, N. Y. ROCHESTER, N. Y. SYRACUSE, N. Y. SCRANTON, PA.

ReMANUFACTURED
-(ORIGINATED BY US)-
MACHINE TOOLS

TRADE MARK

In the business of Remanufacturing we start with the assumption that the only difference between a new machine and a worn machine is the condition of the moving parts and bearing surfaces. In other words, the material has not deteriorated by use, but rather, if anything, improved. Therefore, if the moving parts and bearing surfaces of all parts are renewed you have, to all intents and purposes, a new machine with seasoned material. Users of the present ten-day-out-of-the-sand machines will appreciate what "seasoned" material means.

RADIAL DRILLS

1—3′ American, single pulley drive.
1—4′ Niles Full Universal.
1—5′ Fosdick Plain.
1—5′ Universal.
1—5′ Niles Full Universal.
1—6′ Putnam Plain.

MILLING MACHINES

2—No. 14 Garvin Mfg. Plain.
2—No. 14 Garvin Plain.
1—No. 18 Kempsmith Plain.
1—No. 32 Kempsmith Lincoln.
1—No. 4 Newton Duplex.
1—Hilles & Jones.
1—No. 2 Beaman & Smith Vertical.

GEAR CUTTERS

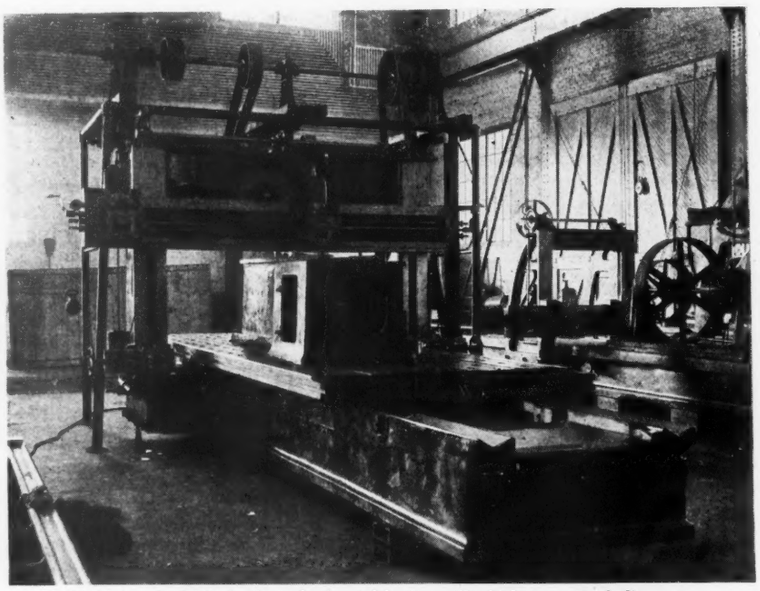
2—No. 11 Gleason Bevel Gear Generators.
1—24″ Fellows Gear Shaper.
1—36″ Fellows Gear Shaper.

PLANERS

1—22″ x 22″ x 6′ Gray.
1—22″ x 22″ x 6′ American.
1—24″ x 24″ x 6′ American.
1—26″ x 26″ x 6′ American.
1—26″ x 26″ x 8′ Gray.
1—30″ x 30″ x 12′ Gray.
1—36″ x 36″ x 8′ Flather, 2 hds.
1—36″ x 36″ x 10′ Whitcomb, 2 hds.
1—36″ x 36″ x 13′ Sellers, 2 hds.
1—48″ x 38″ x 12′ Pond, 1 hd.

ENGINE LATHES

1—15″ x 6′ Von Wyck, taper.
1—16″ x 6′ Walcott & Wood.
1—18″ x 6′ American, Full Q.C.G.
1—20″ x 8′ Whitcomb-Blaisdell, Gd. Hd.
1—24″ x 10′ Walcott & Wood.
1—24″ x 10′ American.
1—36″ x 16′ Johnson Triple Geared, motor drive.
1—36″ x 20′ New Haven.
1—50″ x 14′ Fitchburg.
1—60″ x 16′ Fifield.
1—No. 3 Niles-Bement-Pond Double Axle.
1—Niles Cylinder, 41″ swing.



Replaning the bed of a large horizontal boring mill which was out of alignment.

TURRET AND SCREW MACHINES

1—12″ Foster-Kimball.
4—16″ Pratt & Whitney.
1—20″ Pratt & Whitney Geared Head.
2—22″ Steinle.
1—24″ Foster.
1—1¾″ American Screw.
2—2″ x 24″ Jones & Lamson.

GRINDERS

2—No. 200 Heald Piston Ring.
2—18″ Gorton Disc.
1—No. 11 26″ Besly Disc.
1—No. 23 Landis Plain.
1—1½ Landis Internal.
1—No. 2½ Bath Universal.
1—12″ x 72″ Norton Plain.
24—12″ x 24″ Modern Plain.

PUNCHES AND SHEARS

1—96″ Robinson Power Brake.
1—No. 2 Bethlehem Slitting Shear.
1—No. 1 Wm. Frech Punch.
1—No. 3 Robinson Inclinable.
1—No. 1-B New Doty Geared Punch.

MISCELLANEOUS

1—38″ Colburn Vertical Boring Mill.
1—Gould & Eberhardt Draw Bench.
1—1½″ Morton Keyseater.
1—4″ Bignall & Keeler Pipe Machine.
1—36″ Morton Draw Cut Shaper.
1—No. 2 Lapointe Broaching Machine.
1—No. 104 Consolidated Press.

OUR GUARANTEE: YOUR MONEY BACK IF YOU RETURN MACHINE WITHIN THIRTY DAYS OF DATE OF SHIPMENT. FREIGHT PREPAID. **NO EXCUSES NECESSARY!**

HILL, CLARKE & CO.
OF CHICAGO

625 Washington Blvd., Chicago, Ill.

MACHINES WE OWN—For Immediate Delivery

6—New Cleveland, 2 spindle, high speed, ball bearing Sensitive Drills.
2—New Cleveland, 4 spindle, high speed, ball bearing Sensitive Drills.
4—No. 5—20" Buffalo Stationary Head, back geared Drills.
1—New 21" Cleveland Upright Back Geared, power feed Drill.
3—New Cleveland 25" Sliding Head, back geared, power feed drills.
1—New 28" Cleveland High Speed Upright Drill, with tapping attachment.
1—New 32" Cleveland, Upright Sliding Head.
24—New 20th Century Filing Machines.
1—New Cleveland Profile Grinder, motor driven.
4—New Greenfield Universal Tool & Cutter Grinders.
2—New No. 190 Wells Universal Tool & Cutter Grinders.
1—No. 60 Heald Cylinder Grinder.
4—New No. 1 La Salle Plain Surface Grinders, micrometer adjustment.
1—Used 36" Fellows Gear Shaper.
1—Used No. 2 Knowles Keyseater.
2—New 12" x 5' Cleveland Tool Room Precision Lathes, complete equipment.
3—New 16" x 6' Cleveland Tool Room Lathes, complete equipment.
2—New 16" x 6' Cleveland Quick Change Engine Lathes, regular equipment.
1—Used 24" Libby Turret Lathe.
1—New No. 2 Garvin Universal Milling Machine.
1—Used No. 5 Cincinnati Plain Milling Machine, geared head, single pulley drive, in A-1 condition.
1—New No. 2 Marvel Draw Cut Hack Saw with swivel vise.
1—New No. 1 Chicago Automatic.
1—New Grand Rapids Universal Tool & Cutter Grinder.
1—Used 6' Bickford Radial Drill, gear box drive, very good condition.
1—New No. 2 Garvin Universal Milling Machine.
1—New No. 2½ Rockford Universal Milling Machine.
4—New Adams Farwell No. 1 Gear Hobbers.
1—Used 1¼" Gridley Multiple Spindle Automatic, arranged for motor drive, but without motor.
1—Used No. 2 Le Blond Universal Milling Machine, fine condition.
1—New 20" Canedy-Otto Drill Press.
2—New Cleveland Single Spindle Sensitive Drills.
4—New Cleveland Three Spindle Sensitive Drills.
1—24" x 24" x 5' Morse Planer, one head.
1—No. 13 Garvin Plain Miller.
1—No. 6 Becker-Lincoln Type Miller.
1—No. 1½ Cincinnati Universal Miller.
1—No. 1½ Landis Internal Grinder.
1—16" x 8' Lodge & Shipley Patent Head Engine Lathe, including Universal Chuck.
1—24" x 12" Schumacher & Boye Engine Lathe.
1—3½" x 84" Fitchburg Lo-swing Lathe, all geared heads, single pulley drive, quick change feed.
1—New 24" Walcott, back geared, high duty Shaper.

PARTIAL LIST OF MACHINES LISTED WITH US FOR SALE

BORING MACHINES—VERTICAL

1—New Bullard 24" New Era, with 4 jaw chuck.
1—36" Bausch & Harris, 2 swivel heads.
1—40" King—2 swivel heads.
1—42" Bullard—2 swivel heads, quick change feed.
1—60" Bickford—2 swivel heads.
1—62" King, 2 swivel heads.
1—8' Bickford, 2 swivel heads, equal to new.
1—96" Vertical Cylinder Boring Machine, good as new.
1—10' Niles—2 swivel heads.
1—New 14' Niles Pattern, two swivel heads.

BORING MACHINES—HORIZONTAL

1—No. 2 Rockford, with special large table, good as new.
1—No. 0 Detrich & Harvey, floor type, all geared feeds, universal table, 3½" bar.
1—Niles Knee Type, all geared feeds, 4" bar.
1—No. 33 Lucas Latest Type, 4" bar. Excellent condition.

BULLDOZERS

1—No. 2 Williams & White 16" stroke.
1—No. 5 Williams & White, 13" stroke.
1—No. 23 Williams & White, Belt Driven.
1—Williams & White, 18" stroke.

CRANES—TRAVELING

1—10 ton Whiting, 37'—3" span, 2 motors.
1—New 10 ton 3 motor type, Case—40' span, 220 volt D.C.
1—20 ton Niles—75' span.
1—25 ton Case—28' span.
1—Single Leg, 4 motor, Grantry Crane.

CRANES—LOCOMOTIVE

1—15 ton McMyler, 8 wheel 42' boom.
1—20 ton Brown Hoist 8 wheel 40' boom bucket.

DRILLING MACHINES—RADIAL

1—3' Dreses Plain Single Pulley Drive.
1—4' American Plain, latest type, single pulley drive.
1—New 5' Dreses Plain, July delivery.
1—5' Bickford Plain, arranged for variable speed motor.
1—5' American Full Universal, single pulley drive, practically new.
5—6' Reed Prentice Heavy Duty Ball Bearing.

DRILLING MACHINES—HEAVY DUTY

4—No. 310 Baker.
1—No. 23 Foote-Burt.
1—New No. 416 Baker, high speed, 4" capacity.
2—Style P-3 Baker High Duty. Good as new.

DRILLING MACHINES—SLIDING HEAD

1—26" Barnes Sliding Head, Gang Drill, with 4 spindles. Weight about 6000 lbs.
1—28" J. F. Barnes, good as new.
1—32" Hamilton.

GEAR CUTTING MACHINES

4—New No. 1 Adams Farwell Gear Hobbers.
1—No. 2-A Newark—24" x 8" capacity.
1—36" Fellows Gear Shaper.
1—No. 4 Brown & Sharpe, capacity 48" latest type, equal to new.
1—New No. 4-A Cincinnati, capacity 48" x 12".
1—New No. 5 Lees Bradner, gear Generator, 14" swing, full universal.
1—New 40" Flather Gear Cutter. Immediate delivery.

GRINDERS—CYLINDRICAL—PLAIN

2—New Modern 8 x 30 Self-Contained.
2—New 12 x 24 Modern Self-Contained.
4—New Modern Self-Contained; capacity 12" x 48".
1—14" x 66" Landis.
1—No. 21 Landis, capacity 10 x 30.

GRINDERS — CYLINDRICAL — UNIVERSAL

1—New No. 1—10" x 30" Webster & Perks.
1—New No. 3 Modern, Capacity 13" x 40".
1—New Landis No. 3, Capacity 12" x 42".
1—No. 5 Brown & Sharpe, capacity 22" x 72".

GRINDERS—INTERNAL

1—No. 1½ Landis—good as new.
1—No. 70 Heald, very good condition.

GRINDERS—SURFACE

2—Walker Single Stroke. Good as new.
2—Reed-Prentice Vertical, table capacity 12" x 78", including Magnetic Chuck.
2—13' Pratt & Whitney Vertical.
1—Blanchard—16" wheel, 24" Magnetic Chuck.
1—No. 2½ Walker, including Magnetic Chuck.

HAMMERS—POWER

1—New Williams & White 40 lb., Yeakley.
2—New Williams & White 650 lb., Yeakley.
2—800 lb. Bliss, Board Drop.
1—1200 lb. Billings & Spencer, Board Drop.
1—75 lb. Beaudry.
1—100 lb. Bradley Strap.

HAMMERS—STEAM

1—400 lb. Sellers Single Frame.
1—1100 lb. Pittsburgh Single Frame.
1—3000 lb. Morgan Double Frame.
1—New 6500 lb. Massillon.
1—7 ton Morgan Double Frame—1st class condition.

KEYSEATERS

4—New No. 0 Mitts & Merrill.
1—No. 1 Baker.
1—New No. 3 Mitts & Merrill.
1—New No. 4 Mitts & Merrill.
1—No. 5 Colburn 43" stroke.

LATHES—ENGINE

10—New 16 x 8—Cincinnati Quick Change Double Back Geared, Engine Lathe, immediate delivery.
1—18" x 18' Lodge & Shipley Quick Change. Good as new.
1—27" x 40' Bridgeford, geared head, motor driven, arranged for turning only.
1—New 32" x 18' Bridgeford.
1—32" x 24' Fay & Scott.
1—42" x 20' New Haven Triple Geared, face plate drive.
1—50" x 20' New Haven, triple geared, raising blocks to swing up to 72".
1—51" x 18' Fifield triple geared, face plate drive.
1—60" x 28' New Haven, triple geared. Fine condition.
1—90" x 20' Pond, face plate drive.

LATHES—TURRET

2—21" Gisholt 16" Chuck, quick traverse, taper attachment.
2—2 x 24 Jones & Lamson.
1—3 x 36 Jones & Lamson, single pulley drive.
18—6-A Potter & Johnston.
1—3-A Warner & Swasey hollow hex. bar and chucking equipment.

MILLING MACHINES—KNEE TYPE, UNIVERSAL

1—New No. 1 Cincinnati.
1—No. 2 Milwaukee all geared head, single pulley drive, as good as new.
2—New No. 3 Becker Universal Milling Machines. Immediate delivery.
2 New No. 3 Kempsmiths.
1—New No. 3-A Garvin.
1—New No. 4 Le Blond.

MILLING MACHINES—KNEE TYPE, PLAIN

5—New Gooley & Edlund Type A Briggs.
6—New No. 1½ American.
1—New No. 2 Kempsmith.
1—No. 3 Le Blond, with vertical attachment, Modern Tool.
1—No. 5 Cincinnati, geared head, single pulley drive.
2—New No. 15 Garvin.

MILLING MACHINES—VERTICAL

1—No. 2 Cincinnati, single pulley drive.
1—New No. 4-B Becker.
1—No. 5 Becker-Brainard, with rotary table.
2—New Garvin No. 15, table feed 60".

PLANERS

2—24 x 24 x 6' American late type, one head.
1—New 27" x 27" x 10' Woodward & Powell, 2 heads.
1—28" x 28" x 8' Cincinnati 2 speed latest type, 2 heads on rail.
1—30" x 30" x 16' Hamilton, 2 heads on rail. Good as new.
1—36" x 36" x 8' Gray, 2 heads.
1—36 x 36 x 12' Cincinnati, 2 heads on rail, good as new.
1—40" x 40" x 8' Pond, one heavy swivel head.
1—43" x 33' Detrick & Harvey, frog and switch, 2 swivel heads, motor driven, excellent condition.
1—48" x 48" x 12' Niles, 2 heads on rail.
1—60" x 46" x 15' Patch, 4 heads. Excellent condition.
1—16' Hilles & Jones plate planer.
1—18" Hilles & Jones plate planer.

PUNCHES & SHEARS

1—Alligator Shear, capacity 5" in soft steel.
1—No. 5 Canton Foundry Alligator Shear, capacity 3" square steel, motor driven.
1—5' Loy & Nawarth Squaring Shear, capacity 10 gauge.
1—Bertch Boiler Makers, punches 14" stroke, capacity 1" through 1". Geared Type. Good as new.
1—New Beatty 25" throat, capacity 1" through 1". Delivery 30 days.
1—New Kling, 36" throat, capacity 1¼ through 1". 90 days delivery.
1—New Beatty Single End Punch & Shear, 42" throat, capacity 1¼" through 1". 90 days delivery.
1—New Beatty Single End Punch & Shear, 48" throat. Capacity 1" through 1". 30 days delivery.
1—66" Queen City, capacity 4" through 1" or 2" through 2", weight 53,000 lb. Immediate delivery.

ROLLS

1—Set Stacy 8' Bending Roll, ¾" plate cap.
1—Set 10' Niles, capacity ⅜ to ½".
1—Set 14' Hilles & Jones, capacity ½" plate.
1—Set 20' Niles, pyramid type, capacity 1" to 1¼" plate. Drop and housings. Immediate delivery.

SCREW MACHINES—AUTOMATIC

7—¾" Gridley Multiple Spindle, arranged for motor drive.
1—1¾" Gridley, Multiple Spindle, good as new.
20—3¼" Gridley Single Spindle.
1—No. 0 Brown & Sharpe.
1—No. 2 Brown & Sharpe Turret Forming.

SHAPERS

3—New 18" Hollingsworth.
2—New 20" Steptoe, improved single geared crank.
6—New 24" Hollingsworth Triple Back Geared.
1—New 28" Smith & Mills. Crank.
1—30" x 96" Cincinnati Heavy Duty Open-side Shaper. Excellent condition.
1—36" Morton Draw Cut.

SLOTTERS

1—New Garvin Die Slotter.
1—10" Newton. Good as new.
1—20" Craven. Good condition.

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FOR IMMEDIATE DELIVERY

LATHES

2—No. 1 Ideal Precision Bench Lathes.
18—6" x 30" Dalton Precision Bench Lathes.
10—6" x 36" Dalton Precision Bench Lathes.
1—11" x 5' Worcester Semi Q.C.
2—14" x 5' Carroll & Jamieson Q.C.
4—14" x 6' Carroll Jamieson Q.C.
2—16" x 6' Cincinnati Q.C., D.B.G.
2—18" x 8' Cincinnati Q.C., D.B.G.
2—18" x 8' Bradford Q.C., D.B.G.
1—18" x 10' Bradford Q.C., D.B.G.
1—20" x 10' Bradford Q.C., D.B.G.
1—20" x 12' Lodge & Shipley Q.C.
1—24" x 12' Porter Standard.
1—26" x 14' Rahn-Mayer-Carpenter.
1—32" x 16' New Haven.
1—38" x 16' Fifield Triple Geared.
1—42" x 16' Niles D.B.G.
1—48" x 20' New Haven.
1—60" x 25' Fifield Triple Geared.
1—4½" x 84" Lo-Swing (new).

GEAR CUTTERS

2—No. 3 26" Brown & Sharpe Automatic.
1—No. 4 48" Brown & Sharpe Automatic.
1—No. 4 36" Brown & Sharpe Automatic.
2—36" Fellows Gear Shapers.
1—No. 6 Fellows Gear Shaper.
1—No. 1 Farwell Automatic Gear Hobber.

GRINDERS

2—No. 1 Fraser Universal.
1—No. 2 Fraser Universal.
2—No. 1 Wilmarth & Morman Universal.
1—No. 2 Bath Universal.
1—6" x 32" Norton Plain.
1—10" x 24" Landis Plain.
1—10" x 36" Landis Plain.
3—No. 1 Wilmarth & Morman Surface.
2—No. 2 Wilmarth & Morman Surface.
2—No. 3 Wilmarth & Morman Surface.
1—No. 6 Bryant Internal.
1—No. 6A Bryant Internal.
1—No. 1 Capital Internal.
1—No. 34 Van Norman Internal.
1—14" x 72" Norton Plain.

BORING MILLS

1—39" Rogers Vertical.
1—30" Bullard Vertical.
1—42" King Vertical.
1—72" Niles Vertical.
1—8' Bickford Vertical.
1—10' Niles Vertical.
1—No. 0 Fosdick Horizontal 3⅛" Bar (new).

MILLING MACHINES

5—No. 1 U. S. Hand Millers.
1—No. 1 Standard Hand Miller.
1—No. 3 Rockford Hand Miller.
1—No. 2B Rockford Universal (Used).
1—No. 34 Oesterlein Plain (Used).
1—No. 5 Cincinnati Plain (Used).
1—No. 4 Cincinnati Plain (Used).
1—No. 3 Cincinnati Plain (Used).
1—No. 3 LeBlond Plain (Used).
2—No. 2 Brown & Sharpe Plain (Used).
1—No. 32 Kempsmith Lincoln Type (Used).
1—No. 2 Brown & Sharpe Universal (Used).

SHAPERS AND PLANERS

2—16" Hollingworth Crank Shapers.
1—18" Hollingworth Crank Shaper.
1—24" Hollingworth Crank Shaper.
1—16" Milwaukee Crank Shaper.
1—20" Milwaukee Crank Shaper.
1—16" Smith & Mills Crank Shaper (Used).
1—24" Queen City Crank Shaper.
1—24" Bement Traveling Head Crank Shaper (Used).
1—24" x 24" x 8' Lodge & Davis Planer.
1—26" x 26" x 6' Gray Planer.
1—36" x 30" x 10' Cincinnati Planer, 2 Heads.
1—36" x 36" x 8' Niles 1- Rail Head 1- Side Head.
1—42" x 42" x 10' Davis & Egan Planer, 2 Heads.
1—42" x 42" x 10' Detrick & Harvey Open Side Planer; 3- Heads.
1—42" x 42" x 14' Niles Planer, 2 Heads.
1—60" x 38" x 12' Patch Planer, 4 Heads.
1—52" x 52" x 24' Betts Planer, 1 Head.
1—72" x 72" x 16' Pond Planer, 2 Heads.

SCREW MACHINES

1—No. 3A Warner & Swasey Universal Hollow Hex.
1—No. 3 Warner & Swasey Hollow Hex.
1—No. 7 B.&S. Hand Screw Machine, 2" Cap.
1—16" Oliver Hand Screw Machine, 2¼" Cap.
2—⅝ x ⅞ 5-Hole Cleveland Automatic.
1—1¼" 5-Hole Cleveland Automatic.
1—2" 5-Hole Cleveland Automatic.
2—2" x 2¼ Cleveland Automatic.
1—4¼" Gridley Single Spindle Automatic.
1—No. 54 National Acme 4-Spindle Automatic.
3—No. 75 National Acme 4-Spindle Automatic.

MISCELLANEOUS

1—50 lb. Dayton Helve Hammer.
1—75 lb. Bradley Compact Hammer.
1—1200 lb. Williams & White Drop Hammer.
1—Leighton & Hathaway Single End Punch, 40" Throat, Cap. ¾ in ¾.
1—Set Hillis & Joes Pyramid Type Bending Roll 9½' between housings, Cap. ½" plate.

Honest Prices---Good Service

W. J. BAIRD MACHINERY COMPANY

265 JEFFERSON AVENUE DETROIT, MICH.

MACHINE TOOLS RELIABUILT

A FEW OF OUR GOOD ONES—MANY OTHERS IN STOCK ALL GUARANTEED

MILLERS

New No. 3 Becker Universal.
New No. 4 LeBlond Universal.
Used No. 33 Becker-Brainard Miller.
Used No. 15 Garvin Plain Miller.

PLANERS

1—New, 36 x 36 x 12′ Openside Planer, two heads.
5—New, 48 x 48 x 14, 4 heads, spiral drive, Government specifications.
1—New, Model "A" 42 x 42 x 12 Openside Planer.
3—New, Model "B" 42 x 42 x 12 Openside Planers.
3—Used, 42 x 42 x 14′ Openside Planers.
1—Used, 52 x 48 x 10′ Pond Planer.
1—Used, 52 x 74 x 52 x 24′ Betts, two heads.
1—Used, 54 x 44 x 13′6 Reliabuilt, two heads.
1—Used, 54 x 50 x 12′6 Reliabuilt, two side heads, two rail heads.
1—Used, 66 x 52 x 13′6 Reliabuilt, two heads.
1—Used, 74 x 52 x 14′ Reliabuilt, two heads.
1—Used, 78 x 52 x 14′ Reliabuilt, two heads.
1—Used, 16′ Hilles-Jones Plate Planer.

RADIAL DRILLS

1—Used, 3′ Reed-Prentice Plain Radial, single pulley, tapping attachment.
1—New, 4′ Dreses Plain Radial.
1—Used, 8′ Warren Semi-Universal.
1—Used, No. 17 Foote-Burt four spindle.
1—Used, No. 15 Harrington four spindle.
1—Used, Rockford Six spindle Drill.

GRINDERS

New Premier Tool and Cutter Grinders.
1—Used, No. 5 Brown & Sharpe Universal.
1—Used, 12″ x 72″ Landis Plain.
1—20″ Cylindrical Grinder.
10—New, Dumore Electric Grinders.

LATHES

3—Used, 16″ x 8′ Greaves-Klusman Lathes.
1—Used, 16″ x 8′ Schellenbeck Lathe.
1—Used, 16″ x 8′ Davis Lathe.
1—Used, 18″ x 6′ American Lathe.
1—Used, 18″ x 8′ Cisco Lathe.
1—Used, 20″ x 10′ Lodge & Shipley Lathe.
1—Used, 24″ x 10′ Harrington Lathe.
1—Used, 28″ x 8′ Pond Lathe.
1—Used, 30″ x 10′ Harrington Lathe.
1—Used, 38″ x 16′ D. W. Pond Lathe.
2—Used, 2½ x 36 Marvel Geared Head Lathes.

BORING MILLS

1—Used, Special Bement No. 7 Horizontal Boring Mill.
1—Used, Bement Horizontal Boring Mill, Knee type, 2½″ bar.
1—Used, 7′ Bickford Vertical Boring Mill.
1—Used, Beaman & Smith Floor Type Boring Mill.
1—New, No. 1 Cleveland Horizontal Boring Mill.

AUTOMATICS

1—Used, No. 52 National Acme.
3—Used, 2″ Cleveland Model "A."
1—Used, 2¼″ Gridley Automatic.
1—Used, 2¼″ Cleveland Automatic.

SHAPERS AND SCREW MACHINES

3—Used, No. 32½ Garvin Turret Lathes, wire feed, friction head, back geared, power feed to turret, 2½″ capacity.
15—Used, 20″ x 8′ Roulsted Turret Lathes.
1—Used, Conradson Turret Lathe, 24″ swing, thirteen turret holes.
1—Used, 2″ x 24″ Jones & Lamson Cone Type Turret.

MISCELLANEOUS

1—Used, 42″ Niles Car Wheel Borer.
1—3″ Curtiss Cutting-off Machine.
1—Ten Ton Bedford Crane, two Motor Type, 40′ span.
1—Used, No. 2 Whiton Gear Cutter.

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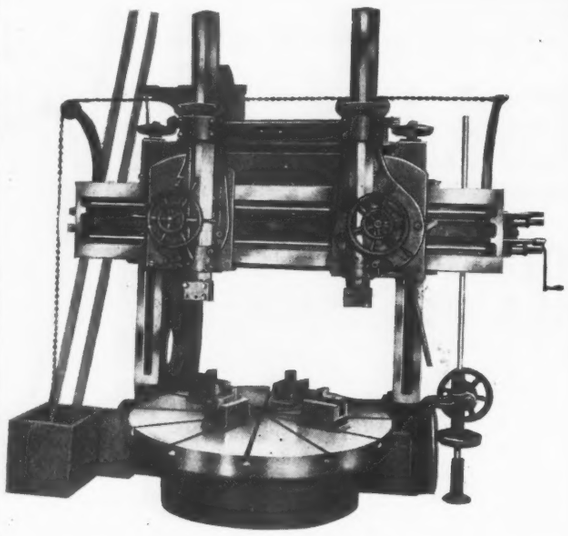
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Used 72″ Niles Vertical Boring and Turning Mill with two swivel heads. Table 68″ diameter. Takes 45″ under tool. Friction feeds. Driven by six step cone for 4″ belt. Complete with four chuck jaws and countershaft. In excellent condition and can be inspected under power.

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MACHINERY FOR SALE

Bought New in 1915-16

Used less than twelve months. Low Prices. Immediate Shipment.

LATHES

5—2¾″ Mod. C. Cleveland Auto. Lathes.
6—No. 11 Amalgamated Lathes.
5—Warren Automatic Nosing Lathes.
3—18″ Reed Grooving and Undercutting Lathes.

MISCELLANEOUS

3—Holden-Morgan Mechanical Wrenches.
8—Fairbanks Scales.
2—Sullivan Shell Grinding Machines.
1—12″ Belt Lacing Machine.
1—No. 22 Frankfort Lead Pot Furnace.
1 Pair Ajax Rolls, Size No. 1, 22″ x 11″, new.

Tools for many of the foregoing machines.
Will be sold subject to previous sale, and inspection, before shipment.
Descriptive circulars and price on application.

THE UNION SWITCH & SIGNAL COMPANY, Swissvale, Pa.

FOR SALE

HYDRAULIC HORIZONTAL PRESSES—Two of them—total ram capacity 125 ton and 300 ton. New and complete in every respect. Manufactured by R. D. Wood & Co. Immediate delivery.

EVERLASTING VALVE COMPANY
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Following used machines for sale, immediate delivery, subject to prior sale. Machines in good running condition and can be inspected in our plant.

One Lincoln Type Milling Machine.
One Cincinnati, Plain No. 4 Miller.
One Hand Miller.
One Mitts & Merrill Key Seater.
One 18″ x 8′ Engine Lathe.
Two—Two-spindle Sensitive Drills.
One 16″ Kelly Shaper.
Two B. & S. Gear Cutters.

THE GRAMM-BERNSTEIN MOTOR TRUCK COMPANY
LIMA OHIO, U. S. A.

A. D. WHITE MACHINERY CO.

108-114 N. Jefferson Street CHICAGO, ILL.

No. 3 Kempsmith Plain Miller; like new.
No. 1½ Valley City Plain Millers (2); new.
No. 1½ Valley City Univ. Miller; new.
10 x 30″ Landis Plain Grinder.
No. 1 Farwell Gear Hobbing Machine.
No. 2 Mitts & Merrill Keyseater.
No. 6 Long & Allstatter S. E. Punches, 4″ throat, cap. ¼″.
Style "G" Rock River S. E. Punch, 12″ throat, cap. ⅜″.
No. 1 Rockford O. B. I. Press.
26″ x 25′ Blaisdell Engine Lathe.
28″ x 12′ Fifield Engine Lathe.
32″ x 14′ Pond Engine Lathe.
36″ x 20′ American Triple Geared Lathe.
20″ Cincinnati Pulley Turning Machine.
3/16″ Grant Rivet Spinner.
3/16″ Adt Riveter.
8 Spindle Valley City Mult. Drill, No. 1 taper.
4′ Gang Plain Radial, Gear Box.
34″ W. F. & J. Barnes Slid. Hd. Drill.
42″ W. F. & J. Barnes Sliding Head Drill.

Desirable Used Machinery For Sale

2—H.D. Bliss Milling Machines arranged for cutting steel pinions to 3 pitch.
1—No. 2 Spindle Pratt & Whitney Profiling Machine.
1—42″ x 12′ Engine Lathe with Raising Blocks, to swing 58″, C.R. S.B.G., 4 step cone.
1—Williamson Metal Band Saw.
1—62″ Kink Boring Mill arranged for grinding.
2—42″ King Boring Mills arranged for grinding.
1—12″ x 6′ American Screw Cutting S.B.G. Engine Lathe.
10—No. 3 Potter & Johnston Mfrs. Lathes with pumps.
1—Cleveland Automatic Screw Machine, 2¼″ Bar capacity.
1—Cleveland Automatic Screw Machine, 2″ Bar capacity.
1—No. 8 Lapointe Broaching Machine.
1—3 ft. Dreses Plain Radial Drill.
1—14 x 48 Q.C. Plain Grinder.

The E. A. Kinsey Company
CINCINNATI — INDIANAPOLIS

First Class Rebuilt Tools

Immediate Delivery

BORING MILLS

2—American 37″ double head vert. boring and turning mills, plain tables.
1—42″ Bullard vert. boring and turning mills, plain table.
1—84″ Pond vert. boring and turning mill, 2 swivel heads, plain table.

DRILLS

20″ Silver w. and l. feed.
20″ Silver b.g., p.f.
24″ Hoefer sliding head, b.g., p.f.
42″ New Haven sliding head, b.g., p.f.
4′ Bickford plain radial drill, gear box drive.

GEAR CUTTERS

24″ Fellows gear shaper.
36″ Fellows gear shaper.

GRINDERS

No. 1 Fraser universal cylindrical grinder.
No. 1 Cincinnati universal cutter grinder.
Landis 10″ x 30″ universal grinder.
Queen City 14″ x 48″ plain grinder, practically new.
Saxon surface grinder, table 36″ x 12″.

LATHES

14″ x 6′ Flather, c.r., h.s.
16″ x 10′ Pratt & Whitney, c.r., h.s.
18″ x 8′ Muller, c.r., h.s.
22″ x 12′ New Haven, c.r., h.s.
24″ x 14′ Putnam, solid spindle, c.r.
28″ x 10′ New Haven, solid spindle, c.r.
30″ x 18′ Draper, q.c.g., c.r., h.s.

MILLING MACHINES

No. 1 Brown & Sharpe universal.
No. 1½ Cincinnati plain, geared feed.
No. 2 Cincinnati plain, geared feed.
No. 2 Cincinnati universal, geared feed.
No. 3 Cincinnati plain.
No. 4 Cincinnati plain.

PLANERS

30″ x 30″ x 6′ Enterprise, one head.

POWER PRESSES

C-3 Ferracute o.b.i. press.
C-4 Ferracute f.b.i. press.
P-2 Ferracute upright press.
P-3 Ferracute upright press.

SHAPERS

18″ Steptoe geared shifting belt.
20″ Walcott geared shifting belt.

SCREW MACHINES AND TURRET LATHES

1/4″ Hartford automatic screw machine.
5/8″ Bardons & Oliver hand screw machine.
2 1/4″ Warner & Swasey screw machine, geared friction head, p.f.

MISCELLANEOUS

4″ Victor pipe machine.
30″ and 36″ Peck, Stow & Wilcox foot power squaring shear.

Send for Complete Purple List

FEDERAL MACHINERY SALES CO.
14 N. JEFFERSON ST., CHICAGO



HAVE YOU TRIED US FOR YOUR USED EQUIPMENT?

Here Are Some Good Starters:

Bickford 8′ Vertical Boring Mill, Two Swivel Heads.
W. E. Gang 2½ ft. Radial Drill, Cone Drive.
Prentice 21″ Sliding Head Upright Drill.
Barnes 25″ Stationary Head Upright Drill.
Potter & Johnston 24″ Crank Shaper.
Root No. 4 High Pressure Exhaust Blower.

LYND-FARQUHAR COMPANY
Machine Tool Values BOSTON, MASS.



Planers and Radials

60 x 60 x 18 Betts 3 heads.
36 x 36 x 18 Pond 1 head.
36 x 36 x 10 Sellers 1 head.
32 x 32 x 10 Niles 1 head.
26 x 26 x 8 Niles 1 head.
24 x 24 x 8 American 1 head.
22 x 22 x 6 Gray 1 head.

4½′ Semi Universal.
4′ Bickford Single Pulley Drive.
4′ Baush Plain.
2½′ Bickford Plain.
5 Sliding Head Drills 24 to 40″.
3 x 36 J. & L. Single Pulley Drive.
2 x 24 J. & L. Single Pulley Drive.

2 BULLDOZERS, Nos. 25 and 26, Williams, White & Co.

No. 6 W. & S. Screw Machine.
32 Baush Boring Mill.
No. 2 B. & S. Heavy Miller.
Press 10′ 6″ Bet. Housings.
Press Bliss Drawing 42,000 lbs.
Press Perkins 16 x 24 Bolster.
No. 25 Becker Brainard Miller.

16, 18 and 24 Bk. Grd. Shapers.
No. 7 Bliss Double Crank Press.
36″ x 12′ Slab Miller.
Landis 20″ x 96″ Universal Grinder.
25″ x 24′ Fifield Lathe.
24″ x 14′ LeBlond Lathe.

THE OSBORNE & SEXTON MACHINERY CO.
COLUMBUS, OHIO

Here You Are

One PUTNAM 48″ x 48″ x 18′ Planer, two heads on cross rail. As good as new.

Three POTTER & JOHNSTON No. 6A Automatic Chucking Lathes. Excellent condition.

Twenty GRANT Spinning Machines about ¼″ capacity. Excellent condition.

Lathes, Milling Machines, Power Presses, Upright Drills, Screw Machines and others, both new and second-hand in stock.

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M. J. Walsh Machinery Co.

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USED MACHINE TOOLS FOR IMMEDIATE DELIVERY

One 24″ Fellows Gear Shaper.
Two 36″ Fellows Gear Shapers.
One No. 3—26″ B. & S. Auto. Gear Cutter.
One No. 400 1/4A Toledo Power Squaring Shears.
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One No. 3 Bardons & Oliver Turret Lathe.
Two No. 12 Modern Plain Grinders.
One No. 1 Garvin Universal Milling Machine.
Two 30″ Bullard Boring Mills.

2 No. 12 Pratt & Whitney GUN BARREL and TUBE DRILLING MACHINES

Immediate Delivery

THE NEW BRITAIN MACHINE CO., New Britain, Conn.

1 Type C-3 Straight Side Double Crank Stamping Press

E. W. Bliss manufacture. Practically new. weight 9000. lbs. Size of bolster plate 16 x 41½″. A bargain. Can make immediate shipment. Will advise price if interested.

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MACHINERY DAVID A. WRIGHT EQUIPMENT CHICAGO

MACHINERY

5—New No. 1½ Plain Milling Machines.
8—No. 3 Federal 1 5/16 Screw Machines.
20—No. 1½ Pratt & Wright 13/16 Screw Machines.
5—14″ Pierce Turret Lathes.
5—1″ x 8″ Pierce Screw Machines.
5—4′ Plain Radial Drills.
10—No. 1 Pratt & Wright Bench Millers.
3—Hardinge Cataract Bench Precision Lathes.
20—18″ x 8′ Heavy Duty Wright Lathes.
18—24″ x 10′ Milwaukee Engine Lathes.
34″ to 96″ Swing Fifield Triple Geared Engine Lathes.

Large stock of New and Used Machinery of all kinds

DAVID A. WRIGHT, Chicago, Ill.

Girard Machine & Tool Co.

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25" x 16' Blaisdell, 12' centers.
24" x 12' Pratt & Whitney.
20" x 10' Hendey.
20" x 8' Reed with taper attachment.
18" x 8' Hendey.
18" x 8' and 10' bed engine lathes with double back gear (12).
16" x 6' new engine lathes with double back gear (10).

TURRET LATHES

2 x 24 Jones & Lamson geared head (5).
2 x 26 Pratt & Whitney all feeds, bar equipment, back geared and friction head.
No. 3 Smurr & Kamen automatic chuck (10).
No. 6 Brown & Sharpe, roller feed (2).
No. 4 Brown & Sharpe, roller feed (2).

Also a large assortment of other makes.

Complete list No. 93, covering big stock, just off the press.

All machines for immediate delivery.

E. B. Stickley Machinery Co.

GOEBEL BLDG. DETROIT, MICH.

1—64" BETTS HORIZONTAL BORING MILL, 4" BAR.
1—24" GISHOLT TURRET LATHE.
2—3 x 36" JONES & LAMSON, BAR EQUIPMENT.
1—3/4" WARNER & SWASEY SCREW MACHINE.
1—24" KELLY BACK GEARED SHAPER.
1—NO. 3 WILMARTH & MORMAN SURFACE GRINDER WITH MAGNETIC CHUCK.
1—22 x 10 HAMILTON LATHE.
1—NO. 59 TOLEDO DOUBLE GEARED STRAIGHT COLUMN PRESS.
2—NO. 59 1/4 TOLEDO DOUBLE GEARED STRAIGHT COLUMN PRESSES.
3—NO. 666 TOLEDO KNUCKLE JOINT GEARED EMBOSSING PRESSES.
1—D.G. NO. 55 FERRACUTE PRESSES.

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AVAILABLE FOR IMMEDIATE DELIVERY

One Fitchburg Engine Lathe, 52" x 20' bed, geared face plate drive, compound rest; excellent shape.
One Pair Niles Bending Rolls No. 2, 8' x 10" dia., pyramid type, good as new.
One Pair of 4' Light Bending Rolls.
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One Horizontal Punching and Bending Machine.
One Oster 6" Pipe Machine.
One Heavy Steel Body Armor Plate Punch.
One 6' Cornice Brake.
One 8 x 8 Air Compressor with Receiver and Tools.
One American Tenoning Machine.
One American Mortising Machine.
One 36" Band Saw.
One Iron Saw Table.

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137 Oliver St. BOSTON, MASS.

DAY MACHINERY CO.

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LATHES

26" x 12' Newark C.R., P.C.F.
36" x 16' Putman C.R., P.C.F.
38" x 16' Fifield Triple Geared.
42" x 16' Niles C.R., P.C.F., D.B.G.
48" x 20' New Haven C.R., P.C.F., Q.C.G.
102" x 32' Triple Geared Screw Cutting.

PLANERS

42" x 42" x 10' Detrick & Harvey Openside. Two heads on cross rail, one side head.
60" x 38" x 12' with Sellers Spiral drive to table. Two heads on cross rail, two side heads.
72" x 48" x 14' Gray. Two heads.
82" x 56" x 10' Woodward & Powell. Two heads.

BORING MACHINES

36" Brown & Sharpe Vertical with one turret head.
42" King Vertical. Two swivel heads.
72" Niles Vertical. Two swivel heads.
10' Niles Vertical. Two swivel heads.
Betts Horizontal with 4" bar.
Bement Horizontal Floor Type with 5" bar.
2—New Gray Horizontal with 6" bar. Immediate delivery.

DRILLING MACHINES

2—No. 12 Pratt & Whitney Gun Barrel or Tube Drilling Machines. Capacity 3" drill 51" long.
Four Spindle Moline Drilling and Boring with special size adjustable table.
Ten Moline "Hole Hog" Single Spindle 3" capacity.
Two Spindle Foote-Burt Heavy Duty Drilling and Boring Machine.
Four Spindle Niles Heavy Duty Rail Type, Working Surface of Table 24" x 10' 4".

MISCELLANEOUS

8" Heald Ring Grinder Magnetic Chuck, 220 V., D.C.
No. 60 Heald Cylinder Grinder.
7-ton Morgan Steam Forging Hammer.
24" Bement Heavy Duty Shaper.
4—No. 2 Brown & Sharpe Automatic Screw Machines. Old style 3/4" capacity.
No. 2 Lapointe Broaching Machine.
2—No. 12 Pratt & Whitney Gun Barrel Tube Drilling Machines, capacity 3" x 51".

What Have You For Sale?

USED MACHINE TOOLS

LATHES

1—26 x 16 Bridgeford.
1—26 x 22 New Haven.

DRILLS

1—20" Barnes, all geared.
4—No. ½, 3 Spindle Avey High Speed, Bench Type.
2—5 ft. Baush Radial.
1—6 ft. Baush Radial.

GRINDERS

2—No. 23 Brown & Sharpe Cylinder.
1—No. 170 Wells Universal Tool & Cutter.
1—No. 6-18" Besly Double Spindle, Ring Wheel.

MILLING MACHINES

1—No. 0 Bickett Vertical Miller & Profiler.
1—No. 2-A Becker Vertical.

PRESSES

6—Straight Sided Inclined Gang, 1¼" stroke.
2—Straight Sided Inclined Gang, 2¼" stroke.
1—No. 2½ Consolidated Plain Inclinable.

MISCELLANEOUS

1—No. 2 Smurr & Kamen Hand Screw Machine.
1—24 x 24 x 6 ft. Hamilton Planer.
1—No. 2 Bilton Automatic Gear Cutter.
1—No. 3 Canton Portable Crane & Hoist.
1—No. 7 Bellvue Industrial Furnace for gas.
1—No. 40 Connersville Pressure Blower.
1—No. 2 Davis Key Seater.
1—No. 1 Racine High Speed Hack Saw.

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FOR SALE

30" Fosdick Radial Drill, Gear Box..	$ 350
11" x 5' Rockford Lathe and Chuck..	225
12" x 5' Star Lathe, draw Collets....	300
13" x 5' Barnes Lathe and Chuck....	175
18" x 10' Bradford Lathe with Chuck..	750
18" x 8' American Q. C. G.....	950
21" x 16' Fifield Lathe.....	600
4" Armstrong Auto. Pipe Machine....	175
Steptoe No. 2 Pl. Miller.....	600
8 Potter & J. 6-A Automatics.....	1300
¾" Warner & S. Screw Machine.....	275
Shaper, Niles-Bement-Pond 16".....	575
20 Sp. Fox Multiple Drill, 1".....	3200
No. 1 Shinn Metal Band Saw, new....	165
Case Hardening Furnace.....	75

B. C. ALLEN MACHINERY CO.
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FOR SALE

1—Brown & Sharpe No. 4 Plain Screw Machine.
2—Brown & Sharpe No. 2 Plain Screw Machines.
4—3 x 18 Norton Grinders.
2—No. 74 National Acme Automatic Machines.
2—No. 54 National Acme Automatic Machines.
3 South Bend Lathes, 12" swing.
1—Peter Garloch Boring Machine (wood).
1—Peter Garloch Wood Turning Machine.

Box A332, care Machinery
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New Planers—
Immediate Delivery

3-24" x 24" x 6' Powell Standard Planers. Now in New York storehouse, boxed for export.

Full information on application

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200 ton H. P. Manufacturing Co.
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225 ton Niles-Bement-Pond Co.
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New Presses for immediate shipment. Write for complete specifications of the press you need

Co-operative Engineering Company
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Cincinnati Ohio, U. S. A.

SECOND HAND Machine Tools

1—⅜ Cleveland Automatic Screw Machine.

4—⅝ Automatic Screw Machines.

6—¾ Hartford Automatic.

6—1⅜ Hartford Automatic.

5—2" Cleveland Automatic.

2—2" Davis & Egan Automatic.

1—2¼ Gridley Automatic M. D. single.

2—1½ x 6 Gray Screw Machines.

1—22 x 22 x 5 S. H. Ames Planer.

1—36 x 36 x 16 D. H. Hewes & Phillips Planer.

1—No. 1 Cincinnati Cutter and Tool Grinder.

1—24 x 8 Schumacher & Boye Lathe.

Brownell Machinery Co.

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1—No. 5 Perkins Single Action Power Press.
1—No. 68 Zeh & Hahneman Double Action Drawing Press.
1—No. 4-J Standard Single Action Power Press, new.
1—No. 2 Standard Broaching and Drawing Machine, 24" stroke.
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1—500 lbs. Standard Automatic Drop.
1—200 lbs. Standard Plain Drop.
5—Leland Gifford Routing Machines.
1—No. 3 B. & S. Automatic Gear Cutter, spur gears only.
1—18" Becker Brainerd Automatic Gear Cutter, spur and bevel gears.
1—No. 3-A Cincinnati Automatic Gear Cutter, new.
1—No. 11 Atlas Plain Grinder, 10 x 30.
2—Landis Plain Grinders, 10 x 30.
1—No. 1 Norton Universal Tool and Cutter Grinder, new.
1—No. 2 Norton Universal Tool and Cutter Grinder, new.
1—No. 1 Morse Universal Grinder, new.
1—6" Hurlbut & Rogers Accelerated Speed Cutting-off Machine.
19—Garvin No. 22 Monitor Turret Lathes, with air chucks.
10—Southworth No. 2 Turret Lathes, with air chucks.
1—20 x 8½ American Tool Works Lathe, compound rest, hollow spindle, Q.C.G. device.

New and Second Hand Machinery

NEW Ferracute Presses for immediate shipment

C-1, with bolster, bushing and elevator, 1½" stroke, ram knockout.
C-3, with bolster, bushing and elevator, 2" stroke, ram knockout.
C-5, with bolster, bushing and elevator, ram knockout.
P-4 with 2" stroke.

SECOND HAND

Pratt & Whitney five spindle multiple drill.
14" x 8' Rockford lathe, three step cone.
16" x 6' Seneca Falls "Star" lathe, compound rest, quick change gears, taper attachment, pan bed.
18" x 10' Draper lathe, geared head, compound rest.
60" x 26' Thayer-Houghton lathe, compound rest, triple geared face plate.
36" x 36" x 8' Niles planer, one rail head, one side head.
36" x 36" x 10' Whitcomb planer, one head.
1" Landis bolt-cutter.
No. 3 Baker key seater.
1⅝" Pearson back geared screw machine, power feed turret.

MARSHALL & HUSCHART MACHINERY COMPANY

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USED MACHINERY

Immediate Delivery

34" Bullard Boring Mill.
36" Bullard Boring Mill.
60" Bickford Boring Mill.
3" Stover Pipe Machine.
36" Aurora Sliding Head Drill.
1 Spindle H. & W. High Speed Drill.
20" Barnes All Geared Drill.
5' Prentice Plain Radial.
2½' American Plain Radial.
No. 1 Adams Gear Hobber.
No. 12 B. & S. Auto. Gear Cutter.
36" Flather Gear Cutter.
No. 1 Norton Univ. Grinder.
No. 2 Bath Univ. Grinder.
No. 1 Gardner Disc Grinder.
25 lb. Bradley Helve Hammer.
No. 3 Baker Keyseater.
12" x 6' Seneca Falls Lathe.
14" x 6' Flather Lathe.
14" x 6' Hendey, Q.C.G.
16" x 6' Reed Lathe.
16" x 8' Advance Lathe, Q.C.G.
18" x 8' LeBlond.
18" x 10' Prentice Lathe, Q.C.G.
24" x 12' Prentice Lathe.
36" x 14' Fifield Lathe.
No. 1-B K. & T. Univ. Miller.
No. 1 Cinc. Plain Miller.
36" x 36" x 16' Ohio Planer.
42" x 42" x 8' Whitcomb Planer.

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NEW YORK STOCK

1—"Monarch" 22" x 10' Lathe, Quick Change, Double Back Geared.
9—"Cincinnati" 16" x 6' Lathes, Quick Change, Three Step Cone, Double Back Geared, for cutting Metric Threads.
5—"Rhodes" Model No. 2—7" Horizontal Crank Shapers.
5—"Rhodes" Model No. 4—3½" Vertical Crank Shapers.
3—"Steptoe" 20" Back Geared Crank Shapers; Revolving Tables; Speed Boxes.
3—"Steptoe" No. O Back Geared Power Milling Machines; Vertical Attachments.
3—"Steptoe" No. O Plain Power Feed Milling Machines; Vertical Attachments.
2—"Rockford" No. 3 Fly Wheel Inclinable Presses with Tie Rods.
2—"Rockford" No. 5 ditto.
1—"Rockford" No. 4 Geared Press.
2—"Rockford" No. 5 Geared Presses.
2—"Rockford" No. 6 Straight Side Fly Wheel Presses.
10—"Rockford" 20" Back Geared Drills.
10—"Rockford" 20" Plain Drills.
12—"Rockford" 23" Plain Drills, Geared Feed.
9—"Rockford" 24" Sliding Head Drills.
4—"Rockford" 26" Sliding Head Drills.
3—"Rockford" 26" Sliding Head Drills; Tapping Attachment.
1—"Rockford" No. 2 Double Back Geared Universal Miller; Vertical Attachment; Sleeve and Intermediate Gear; Oil Pump.
1—"Rockford" No. 2 ALL GEARED Universal Miller; same equipment as above.
1—"Rockford" No. 2 Double Back Geared Plain Miller; equipment as above.
1—"Rockford" No. 2—C Double Back Geared Plain Miller; equipment as above.
2—"Rockford" No. 2—C Double Back Geared Plain Miller; equipment as above but without Vertical Power Feed.

We Have Many More To Offer.
Send Us Your Inquiries.

Post van der Burg Company New York, Inc.

42 BROADWAY NEW YORK, N. Y.

Look Over This List of Machinery

Niles Boring Mill, 2 swivel heads, 80" table, cone driven.
2" x 24" Jones & Lamson Turret Lathe, cone type.
30" x 30" x 10' Putnam Planer, 1 head, fine condition.
72" x 45" x 16' 6" Pond Planer, 2 heads.
24" x 72" Bement Massive Shaper, single head, rebuilt.
5" Hurlbut-Rogers Cutting-Off Machine, accelerated feed, motor drive, good as new.
5' 6" Niles Plain Radial Drill, belt drive.
18" x 8' Springfield Double Back Gear Engine Lathe, quick change gear attachment.
12" Sellers Slotter, motor driven.
No. 4 Cincinnati Plain Milling Machine, motor driven.
No. 5 Used Cincinnati Milling Machine.
40" King Boring Mill, latest model.
36" x 6' Fellows Gear Shaper, excellent condition.
1—Blanchard Surface Grinder, floor type, motor driven, 220 volts D.C.
Blanchard Floor Type Grinder, motor drive, good as new.

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Saxer-Creider Machinery Co., Inc.

MACHINE TOOLS

Erie, Pa.

Reed Engine Lathe

24" x 30'-0" second hand Reed Engine Lathe with compound rest, complete with all regular attachments, including chain drive and 8 horse power, 240 D.C. motor. Excellent condition. Can be seen in operation.

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243 Stafford St., Worcester, Mass.

The Curtiss-Willis Co.

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Mechanical Equipment
Wire Rope
"We Find Things"

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A Pneumatic Grain Elevator, complete, including 50,000 bushel steel tank, $30,000.00.

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30—50 H. P. 2—60 H. P.
4—75 H. P. 3—100 H. P.
2—125 H. P. 4—250 H. P.
1—400 H. P. 1—500 H. P.

Can use larger and smaller sizes. Give size, steam pressure, age and maker's name.

Co-operative Engineering Company

25 Church Street New York

RIVERSIDE MACHINERY DEPOT

WE OWN EVERY TOOL OFFERED

LATHES

1—60 x 20 Shellenback H.D. Engine Lathe.
3—New 16 x 6 Springfield Ideal Engine Lathes.
1—20 x 8 New Rockford Engine Lathe.
1—16 x 8 Porter Lathe.
1—16 x 8 Reed Lathe.
1—14 x 8 Barnes Lathe.
1—13 x 8 Barnes Lathe.

TURRET AND SCREW MACHINES

1—3 x 36 Jones & Lamson Turret Lathe.
1—4½" Gridley single spindle Automatic Screw Machine.
3—No. 2 Smurr & Kamen Hand Screw Machines.
3—No. 2 Smurr & Kamen Power Feed Hand Screw Machines.
3—14" Pierce Turret Lathes, New.
3—1 x 8 Pierce Hand Screw Machines, New.
3—16" Warner & Swasey P.H. Turret Lathes with air chucks.
4—No. 107 Wells Hand Screw Machines.
2—2" Cleveland Automatic Screw Machines.
1—⅝-¾" Cleveland Automatic Screw Machine.
8—No. 52 National Acme 4 spindle Automatics.
1—No. 53 National Acme 4 spindle Automatic.
2—No. 515 National Acme 4 spindle Automatics.

GRINDERS AND MILLING MACHINES

1—No. 60 Heald Cylinder Grinder.
1—No. 6 Bryant Internal Grinder.
1—New No. 2½ Woods Cylindrical Grinder.
1—New No. 2 Woods Cylindrical Grinder.
3—No. 1 Thompson Cutter and Reamer Grinders, New.
3—No. 1½ American Plain Milling Machines, New.
1—No. 0 Brown & Sharpe Plain Milling Machine.
1—No. 13 Garvin Plain Milling Machine.
4—New Burke Hand Milling Machines.

GEAR CUTTERS

1—No. 6 Fellows Gear Shaper.
6—No. 3-36 Brown & Sharpe Automatic Spur Gear Cutters.
2—No. 3-26 Brown & Sharpe Automatic Spur Gear Cutters.
2—No. 13 Brown & Sharpe Automatic Spur and Bevel Gear Cutters.

PLANERS, BORING MILLS AND SHAPERS

1—60 x 45 x 15' Patch four head Planer.
1—36 x 36 x 12' New Haven Planer, S.H.
1—30 x 30 x 7' New Haven Planer, S.H.
2—24" Milwaukee Shapers, New.
2—16" Milwaukee Shapers, New.
3—20" Milwaukee Shapers, New.
3—20" Columbia Shapers, New.
1—20" Hendey Geared Shaper.
1—26" Davis & Egan Geared Shaper.
1—18" Hendey Geared Shaper.
1—60" Bickford Boring Mill.
1—No. 3 Lucas Horizontal Boring Mill.

DRILL PRESSES

2—24" Milwaukee Drill Presses, New.
1—2 spindle Baker H.D. Drill.
1—16 spindle Natco Drill.
1—12 spindle Pratt & Whitney Drill.
3—20" Buffalo B.G., P.F. Drill Presses, New.
3—20" Buffalo Drill Presses, New.
1—38" New Haven P.G. Drill Press.
1—14" Henry & Wright H.S. Drill Press.
3—8" Langelier H.S. Drill Presses.
1—Hammond Flexible Arm Radial Drill, T.A.
1—3½' Canedy-Otto Plain Floor Radial Drill.
2—14" U. S. Plain Drill Presses, New.
3—20" Excelsior Plain Drill Presses, New.

PRESSES AND HAMMERS

1—No. 14 Bliss Toggle Drawing Press.
1—Waterbury Farrell B.G. Heavy O.B.I. Press.
1—No. 2-W Bliss Wiring Press.
1—No. 21 Consolidated Horning Press.
1—No. 1 Sidney O.B.I. Press, New.
1—No. 2 Sidney O.B.I. Press, New.
1—No. 3 Sidney O.B.I. Press, New.
1—800 lb. Billings & Spencer Roll Board Hammer.
1—No. 2 Williams & White Bulldozer.

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1—20 x 42 Huetteman & Kramer R.H., H.D. Corliss Engine.
1—15 x 20 Russell R.H. Auto. Girder Frame Engine.
1—13 x 16 Erie R.H. 4 valve Automatic Engine.
1—13½ x 16 Taylor Automatic Engine.
1—10 x 16 Brownell R.H. Automatic Engine.

We also carry in stock Steam Pumps, Electrical Equipment, and are in the market to purchase good equipment of all kinds

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Rockford, Flywheel, 1½ H.P. Motor, 3 phase, 60 cycle, 220 volts, A.C.

DRILLS

No. 34 Baush Six Spindle Drill, Sta. Table, 7/8" Spdles.
2—10" Burke Bench.
12", 4-spindle Pratt & Whitney Sensitive.
Quint Drill.

GRINDERS

8" Fairbanks Emery.
No. 60 Heald Bolt Driven Cylinder.
No. 70 Heald, Pump, Gear Box, C/S & (1) Extra Whl. Hd.
No. 1 Cincinnati Plain Cutter & Tool.
No. 12 Gardner Duplex Disc, 18" Discs, without Wheel Press.
2—10 x 30" Landis.
20" x 2" Wet Grinder.
No. 2 Leland & Falconer Double Wheel Wet Tool, with 24" x 1½" Wheels.

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36" x 9 Gould & Eberhardt Horiz. Type Auto. with Regular Equipment.
No. 2 Whiton Auto. Type, with Regular Equipment.

HAMMERS

Williams, White & Co. Power Tire Welding.

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No. 2 Mitts & Merrill, with 3 posts and 20 Cutters.

LATHES

Speed Lathe, Countershaft and compound rests.
16 x 6 Lodge & Shipley Patent Head.
16 x 6 Lodge & Shipley Patent Head, with Turret on Carriage.
16 x 8 Monarch.
18 x 8 LeBlond.
18" x 8' Lodge & Shipley, 3-step cone, EBG Engine.
18 x 10 Monarch.
2—20 x 8 Bradford.

PIPE MACHINE

12" Curtis & Curtis.

PRESS

No. 2 Consolidated Plain Inclinable.

SAWS

No. 2 Hoefer Hack.
3½" Burr Cold.
6" Milford Power Hack.
High Duty Paragon Saw, complete with new Blade.

TURRET LATHES

1¼" Cap. Bardons & Oliver Plain, Round, Hand Feed Turret, Cut-Off and Pan. No Pump, tubing or wire feed. (With Automatic Chuck.)
2" Cleveland Automatic, with Countershaft.
No. 22 New Britain Chucking Machine.
2—No. 23 New Britain Chucking Machines.
3—No. 33 New Britain Chucking Machines.

MISCELLANEOUS

40" Peck, Stow & Wilcox Brake.
72" Niagara Folder.
Builders Foundry Belt Strapping Machine.
Curtis Oil Separator.
Fay & Scott Turret Shears with hand feed, Hex. Turret.
Fay & Scott Turret Shears with hand feed, Hex. Turret.

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2000 H. P. Hydraulic Power Plant (Electric)

Complete with

Large Factory Building

and sufficient land for extensions

Near Niagara Falls

Immediate Possession Good Reasons for Selling

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WANTED

One 50,000 pound used testing machine. Machine to be complete and in first class condition.

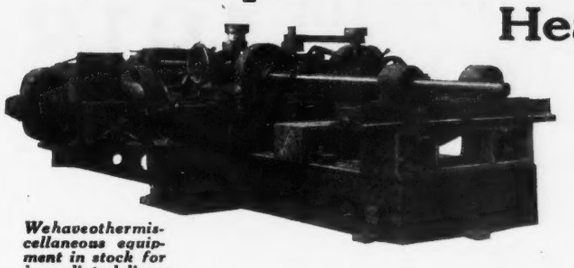
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The "Espen-Lucas" for Shipbuilding and Heavy Engineering Work



We have other miscellaneous equipment in stock for immediate delivery

This double Spindle Boring and Drilling Machine drills to center of 54" as assembled; but end bearings can be extended, bed plate removed and floor plates used for larger work.

Bars are 6" diameter, double back geared, and have three speeds and feeds—which may be increased by variable speed motor. Spindles are independently driven and each requires a separate motor—not furnished with the machine.

Capacity between spindles and end bars 72". Bed plate 60" x 84" x 17". Write, wire or telephone for details.

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221 St. Clair Ave., N. E.

D. M. OSBORNE MACHINERY CO. CLEVELAND OHIO U. S. A.

Horizontal Boring Mills

Two New 6" Horizontal Boring Mills Table Type

Diameter of bar	6"
Faceplate to tail support	78"
Platen	40" x 54"
Travel of Bar, by power	42"
Vertical Movement of Head, by hand	36"
Cross Travel of Platen, by hand	30"
Spindle Speeds, eight	6 to 50 R.P.M.
Spindle Feeds, four	.008 to .040 inches
Weight	21,000 lbs.

Immediate Delivery

THE GRAY MACHINE TOOL CO., Inc.
2651 Main Street BUFFALO, N. Y.

18" x 10' and 16" x 10' Lodge & Shipley Geared Head Lathes with Taper Attachment, Compound Rest and Chucks.

10 x 30 Landis Cylindrical Grinder; first-class shape.

30" x 30" x 8' Pond Machine Tool Planer, one head, arranged for 2.

3—8" Heald Ring Grinders, hand feed magnetic chuck.

36" Gap Geared Shear, 12" blades; weight 5 tons.

18" x 6' Hendey Q.C. Lathe, Compound Taper Attachment and Chucks.

All tools first class and ready

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Monarch 100 H. P. Corliss Engine, used only few weeks, in A-1 condition. Here is a real bargain for quick sale. Address

The Manufacturers Equipment Co., Dayton, Ohio

Wanted—Second hand horizontal steam boiler about fifty to seventy-five horse power. Address

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LYNDHURST, N. J.

HONEST SERVICE

New Machines

2½' Plain Radial Drill.
3½' Plain Radial Drill.
14" x 6' Champion Quick Change Lathe, with taper.
18" x 8' Quick Change Engine Lathe.
No. 4½ Bardons & Oliver Turret Lathes.
No. 4½ Bardons & Oliver Hand Screw Machines.
No. 2 Plain Head Hand Screw Machine, 1 1/16" capacity.
16" Queen City Shaper, cone drive.
20" Queen City Shaper, cone drive.
2—20" Queen City Crank Shapers, gear box drive.
2—24" Queen City Shapers, cone pulley drive.
No. 23 Demco Floor Drill.
No. 32-B Demco Floor Drill, two-spindle.
No. 32-B Demco Floor Drill, three spindle.
3—No. 22 Demco Bench Drills.
2—6 x 6 Peerless Metal Saws.
3—No. 1 Toledo Hand Milling Machines.
No. 2 Two-Spindle Washburn Ball Bearing Drills.
No. 2-B Single-Spindle Washburn Ball Bearing Drill.
23" Stationary Head Upright Drill.
25" Sliding Head Upright Drill.
No. 20 Bliss Inclinable Press.
No. 4 Canton Floor Crane.
Grand Rapids No. 2 Universal Grinder.
Premier Universal Tool and Cutter Grinder.

Used Machines

24" x 24" x 6' G. A. Gray Planer, single head.
6" x 15" Fitchburg Plain Grinder.
11—6" x 12" Gould & Eberhardt Gear Hobbing Machines. Good condition.
3—12" x 24" Gould & Eberhardt Gear Hobbing Machines. Good condition.
No. 3—26" Brown & Sharpe Gear Cutters.
No. 3—36" Brown & Sharpe Gear Cutters.
No. 3—26" Brown & Sharpe Gear Cutters.
Lapointe Machine Tool Co. No. 2 Single Broaching Machine.
No. 2 J. N. Lapointe Double Broaching Machine.
21" Kern Stationary Head Drill, B.G.P.F. and Tapping Attachment.
No. 1 Warner & Swasey Hollow Hexagon Turret Lathe, with Bar and Chuck Equipment.
14" x 6' American Standard Engine Lathe.
No. 2 Bardons & Oliver Turret Lathe.
24" Brown & Sharpe Vertical Chucking Machine, 28" swing.
Adams No. 1 Gear Hobber.
12" x 48" Plain Grinder. Excellent condition.

THE BIGGS-WATTERSON CO.
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IMMEDIATE DELIVERY of CRANES, all leading makes, wide range of sizes. Many may be inspected and tested in operation.

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1876 THE MACHINERY HOUSE OF THE EAST FRANK TOOMEY, Inc. 1918

LATHES

10" x 4" New Climax.
13" x 5'6" New Carroll-Jamieson.
14" x 6' New Carroll-Jamieson Q.B.G.
14" x 8' New Carroll-Jamieson Q.B.G.
4—15" x 6' New Sidney Quick Change Swings 17".
15—7" x 8' New National Q.C.G.
17" x 8' New Sidney Quick Change D.B.G., Swing 19".
18" x 8' Schumacher Boye.
19" x 8' New Sidney Quick Change D.B.G., Swing 21".
20" x 8' Reed.
24" x 20' Reed.
25" x 14' New Sidney Quick Change C.B.G., Swing 27".
32" x 24' Fay & Scott.
24" x 48" x 24" McCabe Double Spindle.

TURRET LATHES

2" x 24" Jones & Lamson Geared Head.
2" x 24" Jones & Lamson Cone Head.
2—24" Davis Chucking Lathes.
No. 56—4 Spindle National Acme Screw Machines.

HORIZONTAL BORING AND DRILLING MACHINES

2½" Bar Warner & Swasey.
2" Bar J. F. Barnes.

SLOTTER

10" Newton.

PLANERS

36" x 36" x 8' Gray, Two Heads.
30" x 30" 10' Fitchburg, One Head.
24" x 24" x 8' Gray.
18" x 18" x 3' Blaisdell.

SHAPERS

4—14" New Steptoe.
4—16" New Steptoe B. G.
16" Bement Traveling Head Shaper.
2—24" New Steptoe B. G.

MILLERS

2—No. 1½ New American Plain.
United States New Hand Miller.
No. 1½ Cincinnati Universal.
No. 2 Burke Bench.

GRINDERS

No. 1 Frazer New Universal Grinder.
12" x 30" B. & S. Universal.
10" x 24" Iroquois.
10" x 20" Bath Universal.
No. 3 B. & S. Universal Tool and Cutter
No. 4 Gardner Disc.

DRILLS

12—No. 1 Langelier Bench.
14" New Excelsior Sensitive.
15" New Demco Roller Bearing Bushed.
15" New Kokomo Hi-Speed Roller Bearing Bushed, capacity ⅞" Steel.
20" New Superior W. & L.
20" New Champion B. G. P. F.
20" New Superior B. G. P. F.
24" New Superior B. G. P. F.
25" New Weigle Tapping Attachment.
30" G. & E. Sliding Head with compound table.
32" New Superior Sliding Head.
36" New Superior Sliding Head.
20" Rockford Heavy Duty.
42" Radial Niles.

HAMMERS

350 lb. Sellers Steam.
250 lb. Little Giant Belt—New.
100 lb. Little Giant Belt—New.
50 lb. Little Giant Belt—New.
25 lb. Little Giant Belt—New.

PUNCHES AND PRESSES

60 ton P. & W. Coining Press.
300 ton P. & W. Coining Press.
1000 ton P. & W. Coining Press.
20" Throat Single and Ridgeway Punch, Cap. 1½", 1".
18" Throat Industrial Double End Geared Punch.
No. 54 New Beloit Punch and Shear.
No. 53 New Beloit Punch and Shear.
No. 52 New Beloit Punch and Shear.
2—No. 2 Stiles Presses.
2—No. 1 Stiles Presses.
2—No. 130 New Max Ams Inclinable Presses.
3—No. 126 A New Max Ams Inclinable Presses.
2—No. 121 Max Ams Inclinable Presses.

METAL SAWS

13" x 16" New Peerless High Speed.
6" x 6" New Peerless High Speed.
Espen Lucas Circular Saw.

MISCELLANEOUS

36" Gould & Eberhardt Spur Gear Cutters.
F. G. Street Horizontal Time Ring Routing Machine.
⅛" to 2" National Six Spindle Nut Tapper.
¼" to ¾" National Six Spindle Nut Tapper.
3/16" to ½" National Five Spindle Nut Tapper.
8—No. 304 A New Oster Pipe Machines.
16" x 10' Automatic Threading Machine.
7' Swing Pitt Lathe.
4" x 15" Cleveland Thread Miller.

FRANK TOOMEY, Inc., 127-131 North Third Street Philadelphia, Pa.

TERMINAL PAYS THE FREIGHT

Our New Policy—On and After July 1, 1918

One Price—One Profit—No Brokerage—Our Own Property Descriptions and Particulars Guaranteed!

MILLERS

"ROCKFORD" No. 0 plain straight arm, 3-slot table, power, long feed, 22 x 6½ x 15; one arbor and new countershaft. Condition very good; $475.

"CINCINNATI" No. 3, full universal, all geared feeds, dividing heads, and all standard equipment. Condition like new; $3100.

"CINCINNATI" No. 2 Vertical Miller, single pulley drive, all geared. Like new; $4000.

PROFILERS

"REED-PRENTICE," 2-spindle, geared driven, same type as No. 12 Pratt & Whitney. Like new; $900.

GEAR CUTTERS

"BROWN & SHARPE," 8 x 36 in., for spur gears, full standard equipment and like new; $1500.

"NEWARK" 6 x 24 in., for spur and bevel gears, full standard equipment. In very good condition; $1050.

LATHES

"PUTNAM" screw cutting, 22 in. x 10 ft., heavy duty double back gears, semi-quick change face plates, tool post, c-s, etc. In excellent condition; $1250.

"REED" screw cutting, 22 in. x 10 ft., full standard equipment. In good condition; $800.

"PRENTICE BROS." 18 in. x 8 ft., quick change gears, double back gears, cabinet legs, new steadyrest, full equipment. Very good condition; $800.

"NATIONAL" 17 in. x 8 ft., quick change and double back gears. NEW; $875.

"CANEDY-OTTO" 16 in. x 6 ft. semi-quick change, standard equipment. NEW; $510.

"CARROLL-JAMIESON" 14 in. x 6 ft., quick change, standard equipment. NEW; $575.

"CARROLL-JAMIESON" 14 in. x 8 ft., quick change, standard equipment. NEW; $615.

"REED" 16 in. x 6 ft., heavy duty, actual swing 18 in., compound rest, set gears, steadyrest, chuck, faceplates, etc. A-1 condition; $585.

SCREW MACHINES

"BROWN & SHARPE" No. 6, with 7-hole hexagon turret and power feed, friction head, oil pan and pump, wire feed, cut-off rest and tool posts, friction c-s. In excellent condition. Bargain; $950.

"GARVIN" No. 32½ with 6-hole hexagon turret and power feed, back geared, friction head, tool posts, wire feed and c-s. Like new; $515. Without wire feed, $375.

"WARNER & SWASEY" No. 2 hexagon turret, power feed, oil pan and pump, about 25 collets, cut-off rest, wire feed and c-s. Good condition; $500.

"NATIONAL-ACME" Automatic, 4-spindle, 2¼-in. capacity. Not a new machine, but includes an abundance of parts and is in very good condition. Bargain; $900.

GRINDERS

"LANDIS" No. 1 Full Universal, single pulley drive, all complete. In good condition. Extra parts; $1050.

"CINCINNATI" No. 4 Full Universal, 18 x 78 in. Like new, all complete; $4150.

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TERMINAL MACHINE CO., 404-408 Broome St., New York City

Guaranteed Machinery

All Owned By Us—Immediate Delivery

LATHES

2—13 x 6 Carroll-Jamieson semi-quick change (new).
1—14 x 8 Lodge & Shipley quick change, taper attachment.
1—14 x 6 Prentiss quick change, complete.
2—15 x 6 Sebastian gap (new), complete.
2—15 x 6 Maydrite, brand new, complete.
1—16 x 32 x 12' Fay & Scott gap, with chuck.
1—18 x 8 Mueller quick change (new), double back geared.
2—16 x 8 Greaves & Klusman, complete.
1—21 x 36 x 16 LeBlond gap, heavy duty, quick change, double back geared (new).
2—26 x 14 Schumacker & Boye, double back geared, quick change, complete.
1—28 x 14 Pittsburgh double back geared, complete.
1—24 x 48 x 10 Rahn-Larmon, extension bed, quick change, taper attachment (new).
1—90 x 20' face plate drive Pond, complete.
1—26" blocked to 32" x 16' Lodge & Shipley quick change double back gear engine lathe.

MILLERS

1—No. 24 Ohio Universal (new).
1—No. 34 Ohio Universal (new).
1—No. 4 LeBlond Universal (new).
1—No. 2 Kempsmith Universal (new).
1—No. 2 Cincinnati Universal (new).
1—No. ½ Valley City Universal (new).
1—No. 1 Kempsmith Universal (new).
1—No. 1 Cincinnati Universal (new).
1—No. 2 Kempsmith Plain (new).
1—No. 3 LeBlond Plain, with vertical attachment.
3—No. 25 Becker Plain.
2—No. 4-B Becker, with rotary table.
1—No. 5 Becker Vertical, with rotary, complete.
1—No. 6 Becker Vertical, with rotary, complete (new).
1—Becker-Brainard Slab Miller, working surface of table 84 x 20, distance between housings 42", slightly used, good as new.
1—Brown & Sharpe Plain Miller, equivalent to No. 5.

TURRET LATHES

1—2 x 24 J. & L. cone drive, bar equipment.
1—3 x 36 J. & L. geared head, chuck equipment.
1—3 x 36 J. & L. geared head, bar equipment.
1—2½ x 26 Pratt & Whitney, flat turret, chuck equipment.

SHAPERS

1—14" Steptoe, brand new.
1—14" Smith & Mills (new).
1—16" Smith & Mills (new).
1—24" Potter & Johnston Universal (new).
1—28" Smith & Mills triple geared (new).
1—14" Walcott Geared Shaper with countershaft.
1—16" Ohio Crank Shaper, with countershaft.
1—26" Davis & Egan Geared Shaper, with countershaft.
3—7" Rhodes Horizontal Shapers.
2—No. 1 Rhodes Vertical Shapers, brand new, complete.

BORING MILLS

1—Newton-Duplex Horizontal, 2½" bar.
1—Binsse Horizontal, 2½" bar.
1—No. 3A Fosdick Horizontal, 3⅛" bar (new).
1—24" Bullard Vertical Turret Lathe, turret and side head.
1—36" Bertram Vertical, single turret head (new).

GRINDERS

1—No. 1½ Cincinnati Cutter and Reamer (new).
1—8 x 30 Norton Plain (new).
1—10 x 72 Brown & Sharpe Plain, complete.
1—No. 3 Modern Universal (new).
1—No. 3 Landis Universal (new).
1—No. 5 Duplex Internal and External.
1—No. 60 Heald Cylinder.
1—No. 75 Heald Internal.
1—Pratt & Whitney Vertical Surface Grinder, will grind wet and dry, with magnetic chuck, complete, good condition, guaranteed A1.
1—No. 3 Brown & Sharpe Universal Grinder, in good condition, equipped only with tail and head stock.
1—No. 21 Landis Plain Grinder, used, complete.

PLANERS

1—26 x 26 x 7 Pond heavy duty, single head.
1—36 x 36 x 8 Flather, two heads on cross rail (new).
1—30 x 30 x 8 Harrington, single head.
1—36 x 36 x 10' Woodward & Powell, two heads on cross rail (new).
1 48 x 48 x 16' Detrick & Harvey open side planer, two rail heads, one side head.
1—30 x 30 x 6 Heavy Duty Putnam Single Head Planer, condition like new.

AUTOMATIC SCREW MACHINES

1—No. 2 National Acme, four spindle.
2—4½ Gridley.
1—⅝" Cleveland, single spindle (new).
1—¾" Cleveland, single spindle, complete.

RADIAL DRILLS

1—3' Morris plain (new).
1—3½' Cincinnati-Bickford, single pulley drive (new), plain.
1—4' Prentiss, single pulley drive, plain.
1—5' Prentiss, plain.
1—6' C & C portable radial girder drill, complete with motor and carriage on wheel.
1—4' Cincinnati-Bickford Single Pulley Drive Universal Radial Drill, used, condition like new.
1—4' Bickford Plain Radial Drill, complete.
1—5'6" Niles Plain Radial Drill, complete.
1—3' Prentiss Plain Radial Drill.

CRANES

1—5-ton Locomotive, standard gauge.
1—20-ton McMyler, boom 45 ft., 8 wheel, completely overhauled.
2—3 ton P. & H. Cranes, new 22'2" Span, lift 25', having 3 motor cage control, 220 D.C.
3—3 ton P. & H. Cranes, new 21'6" Span, 45' lift, having 3 motor cage control, 220 D.C.

MISCELLANEOUS

2—14" Nutter & Barnes Cold Saws.
1—No. 2 Royersford Double End Punch and Shear, capacity ½", 12" throat.
1—Large Weis & Coes Punch and Shear, capacity ¾", 18" throat.
1—Newbold Circular Shear, 14" blade, 22" throat.
2—48" Throat Beatty Heavy Duty Single End Punch, brand new, angle jaws and shearing attachment.
1—3½O Bliss Toggle Press, practically new.
5—No. 5 Langelier Swaging Machines.
1—2½" Detrick & Harvey Bolt Cutter, no dies, in good condition.
1—500 lb. Kirkwood Steam Hammer.
1—1000 lb. Billings & Spencer Board Drop Hammer.
1—300 lb. Beaudry Hammer.
1—500 lb. Kirkwood Steam Hammer.
1—300 lb. Billings & Spencer Board Drop Hammer.

Also Engines, Boilers, Cranes, Air Compressors, Presses, Drop Hammers, Blowers, Motors, etc. We will look up for you any machine you want.

SPECIALS—SPECIALLY PRICED

3—No. 4 Manville Double Stroke Headers, and

7—No. 4 Manville Single Stroke Headers, capable of taking material up to ¾"—cold.

19—No. 4 Manville Thread Rollers. Largest diameter of screw, ¾. Greatest length of threads, 3⅜.

13—Bolt Trimmers, manufactured by Manville. Largest blanks handled, ⅜. Longest, 4½. Shortest, ¾. Stroke of punch, 5".

10—Ferracute Presses.

5—American Gas Furnace Co.'s Carbonizing Tempering Furnaces, including electric heat control. All in first-class condition.

We have in our warehouse for immediate delivery about 500 modern machine tools. Are always equipped to fill any demand. All machines guaranteed. Try us.

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NEW YORK CITY

Office: 25 Church Street **Warehouse: 52 Walker Street**

Practically New Equipment

16-in. x 8-ft. LeBlond Tool Room Lathe, quick-change gear, taper attachment, relieving attachment.

18-in. x 8-ft. Oliver Double Back Geared Lathe, quick-change gear.

18-in. x 8-ft. Oliver Lathe, Double Back Gear, quick-change gear, taper attachment and oil pan.

19-in. x 10-ft. LeBlond Heavy Duty Manufacturing Lathe, double back geared, semi-change feed, cross and longitudinal stops, taper attachment.

21-in. x 12-ft. LeBlond Heavy Duty Manufacturing Lathe, double back geared, semi-change feed, cross and longitudinal stops, taper attachment.

No. 2 Cincinnati Cone Type Universal Milling Machine.

No. 3 Cincinnati Single Pulley Drive Universal Milling Machine.

3¼ Gridley Automatic Screw Machine.

No. 56, Four-Spindle, 2¼-in. National-Acme Automatic Screw Machine.

2—3¼ x 36 Cincinnati Acme Flat Turret Lathes, chucking equipment.

No. 2 Woods Universal Cutter and Tool Grinder.

Gisholt Machine Tool Co.'s Universal Tool Grinder.

Style "E" Point Wilmarth & Morman 3-phase, 60-cycle, 220-volt A.C. Drill Grinder.

No. 2 Gardner Machine Co.'s Disc Grinder, with two 14-in. ring wheel chucks; equipped with 3-phase, 220-volt, 60-cycle A.C. motor.

10 x 24 Landis Plain Self-Contained Grinder.

22 x 72 Pratt & Whitney Vertical Surface Grinder, with magnetic chuck, 45-hp., 3-phase, 60-cycle, 220-volt A.C. motor.

2—14-in. Allen High-Speed Ball Bearing Drills.

26-in. Barnes All Geared Sliding Head Drill, with tapping attachment.

2½-ft. Arm American Radial Drill, with speed box drive and round table.

Fox Multiple Spindle Drill, with 14 x 32 rectangular head, bored for 20 spindles and equipped with 16.

36-in. Bullard Vertical Turret Lathe, with cutting lubricant system.

14-in. Gould & Eberhardt Crank Shaper.

No. 3 Lapointe Machine Tool Co.'s Broaching Machine.

150-ton, 36-in. Lourie Hydraulic Tire Wheel Press.

2-C, 6 x 6 Racine High-Speed Metal Cutting Machine, with three-speed attachment, 220-volt, 3-phase, 60-cycle motor.

National Brake & Electric Co.'s 300-cu. ft. Air Compressor, with 54-hp., Allis-Chalmers, 3-phase, 60-cycle, 220-volt motor, with 4 x 12 tank.

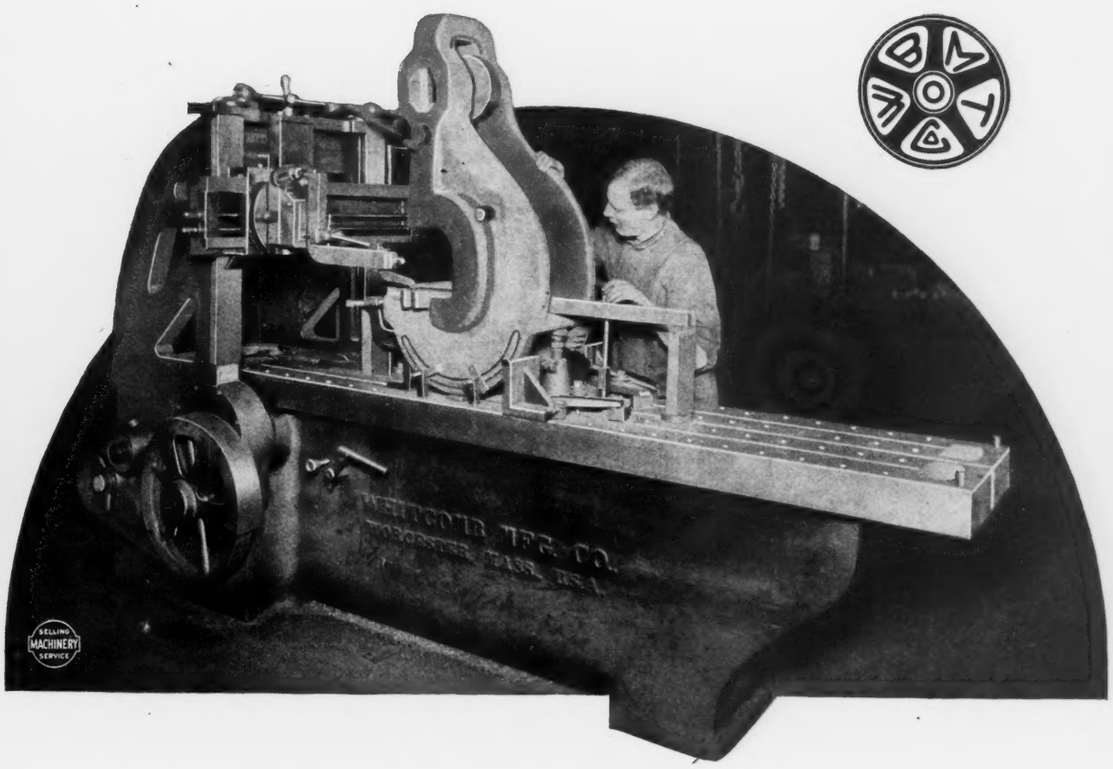
46-ft. 10½-in. Span Case Three-Motor Crane, 20-ft. lift; equipped with two 15-hp. and one 3-hp. General Electric motors, 3-phase, 60-cycle, 220-volt, and operator's cage.

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THE W. M. PATTISON SUPPLY CO.

CLEVELAND **OHIO, U. S. A.**





A Mean Job—

Planing the bed of a power press frame allows not the slightest variation in the cutting stroke. That's why it's put up to the Whitcomb-Blaisdell Second Belt Planer in the Standard Machinery Company's plant at Providence.

They make all kinds of machinery in this shop, and the mean job—the special piece of machining—always goes to their Whitcomb-Blaisdell, because, in spite of its twelve years' service, it is a machine they can depend on for A-1 results.

Noiseless operation is a characteristic of this well-designed machine, and distinctive control features facilitate handling the wide range of work to which it is adapted; self-locking dogs, that can be adjusted by hand, and patented cross rail binder, instantly adjustable from a central point.

These and other interesting construction details are fully described in our Planer Catalogue. Write for it.

Whitcomb-Blaisdell Machine Tool Co.
Worcester **Mass., U. S. A.**



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You Can Depend Upon A TRAHERN Pump

TRAHERN Pumps are simple in construction, efficient, economical and CAN BE DEPENDED UPON to get any lubricant to the cutting tool in copious streams free from pulsations. They are provided with an automatic relief valve which enables you to cut off the supply at discharge without stopping the pump, eliminating expense of an independent relief valve.

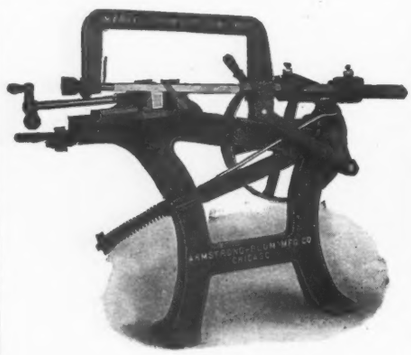
Let us furnish you with complete details and illustrations showing the use of a TRAHERN Pump on various machines.

TRAHERN PUMP COMPANY

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ROCKFORD, ILL. 1328 BROADWAY, NEW YORK CITY

Two High Grade Hack Saws

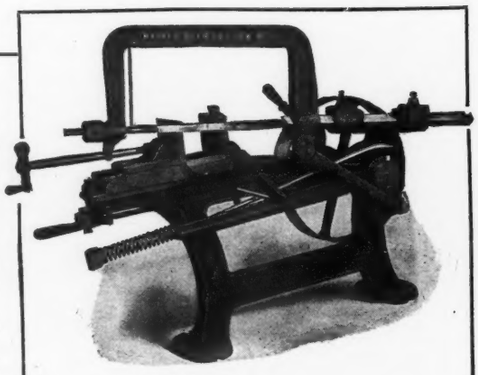


Marvel Hack Saw No. 1

Marvel Hack Saw No. 1 has capacity for stock 4″ x 4″, is adapted for general shop use. Pressure on saw blade is adjustable. Stops automatically when work is cut off.

The Marvel Draw Cut Hack Saw Machines live up to their name in every particular. They are clean-cut, hard working, built for strain and endurance.

Both machines combine accuracy with durability. Write for details.



Marvel Hack Saw No. 2

Marvel Hack Saw No. 2 is a twin brother to No. 1 but has capacity up to 6″ x 6″ on the long stroke and 8″ x 8″ on the short stroke. Automatic stop and heavy vise swivelling in either direction are features of this machine.

ARMSTRONG-BLUM MANUFACTURING CO.

343 North Francisco Avenue CHICAGO, ILLINOIS, U. S. A.



The SIPP *PRIMER*

Lesson No. 2—Oiling

What is this man doing?
He is oiling the spindle of the Sipp Drilling Machine.

Why, are not all drilling machine spindles oiled in that way?
Hardly!

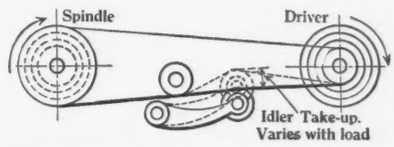
You see the oil groove sealing-shim he is holding clear in his left hand?

Yes, what is that for?
It is to seal the oil grooves after-oiling against the entrance of dirt and foreign matter into grooves and bearing.

Does the Sipp need any other lubrication attention?
All the transmission gears, its ball bearings, etc., turn in oil baths, which once filled, last almost a year.

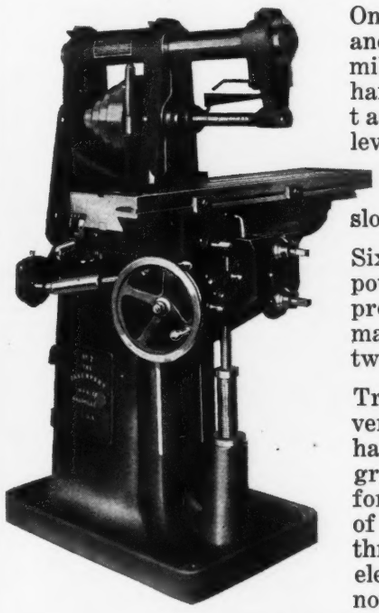
So you see, the Sipp is more independent of the personal factor than any other drilling machine in the world. It is fool-proof.

THE SIPP PRINCIPLE



THE SIPP MACHINE CO.
PATERSON NEW JERSEY

The New DAVENPORT
No. 2 Milling Machine



On this new hand and power feed milling machine, hand feed is obtained through lever, for rapid feed, or wheel, for slow feed.

Six changes of power feed are provided by the manipulation of two levers.

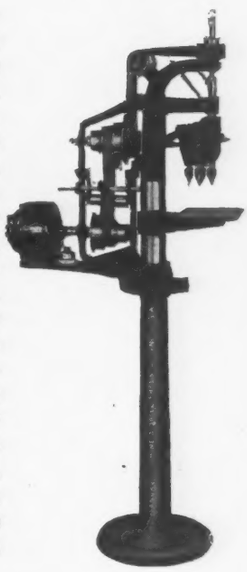
Transverse and vertical screws have adjustable graduated dials for gaging depth of cut. Hole through floor for elevating screw not necessary.

Send for full particulars.

THE DAVENPORT MFG. CO.
MEADVILLE PENNSYLVANIA

Landau 4 in 1 Drill Press

The Landau is four machines embodied in one. Each spindle is a separate machine. One spindle drills, one counterbores, one countersinks, one taps. While one operates, the others remain idle. Only enough power required to operate one spindle. Only 12 x 28-in. floor space required. Runs by motor or countershaft. The r.p.m. is changed quickly by simple lever shift to suit the job in hand. Similar in operation to the turret lathe. We also have a bench style machine.



Send for details

Landau Machine & Drill Press Company, Inc.
19 W. 44th Street New York City



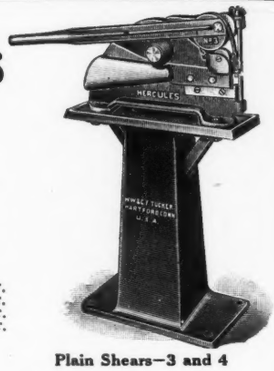
Hercules Shears and Rod Cutters

In Six Sizes

Are preparedness tools in that they are always ready to do that job of sheet, bar and iron or soft steel rod cutting. No tools to adjust, belts to break, no drag on the power plant. Feed the material to the machine and work the lever with low cost labor. Rods can be cut with ends ready to thread, or spin over forming rivet head without additional machining.

No. 0 cuts 1/16″ flats and under.
No. 1 cuts 3/16″ flats and under
No. 2 and 3 cuts 1/4″ flats and under.
No. 4 and 5 cuts 5/16″ flats and under.

No. 0 cuts rods 1/8″, 3/16″, 1/4″ and under.
No. 1 cuts rods 1/4″, 3/8″, 1/2″ and under.
No. 2 cuts rods 3/8″, 1/2″, 5/8″ and under.
No. 5 cutz rods 1/2″, 5/8″, 3/4″ and under.



Nos. 1, 2 and 5

Send for Shear Catalog

Plain Shears—3 and 4

Manufactured and for sale by **W. M. & C. F. TUCKER** HARTFORD, CONN., U. S. A.

ADDITIONAL IMPROVEMENTS IN

SHEPARD LATHES



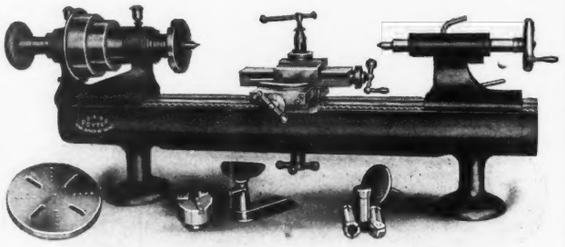
The New "SHEPARD"

12 Inch Semi Quick Change Screw Cutting Engine Lathe

Several new machines have been added to the New Shepard Line, among them this all geared head model, with individual motor drive mounted on the headstock. This machine has all the distinctive New Shepard features—the reversing lever in the headstock, which obviates stopping the machine to reverse, being one of the more important. Complete description and full line on request.

SHEPARD LATHE COMPANY
Canal and Jackson Sts. Cincinnati, Ohio

S·A·POTTER *Precision Bench Lathe*



Rigid yet not Cumbersome

Bed is sufficiently wide to insure rigidity without the addition of undue weight. Head and tail stocks are carefully fitted to master plates. Bearings are adjustable for wear. Large dials on compound rest are instantly adjustable. Swings 7″. Collet capacity ¾″. Three speed grinding countershaft.

Ask for circular.

S. A. POTTER TOOL & MACHINE WORKS
79 EAST 130th STREET, NEW YORK CITY

SWIND SAWS SAVE SPACE

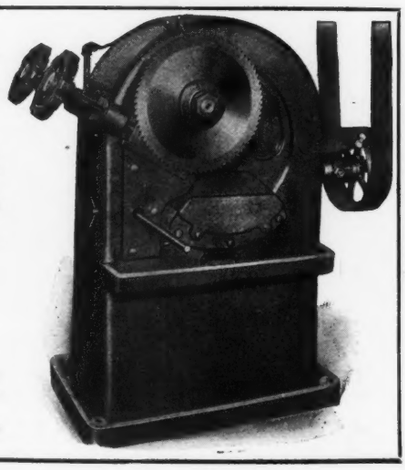
The Swind Cold Saw is designed for use where every foot of floor space counts. You can put it in any corner of your stock room.

THE Swind Cold Saw has an improved automatic device for correctly feeding the saw to the work.

The Swind Cold Saw is unusually rigid and powerful for its size, and there is ready access to all working parts. Capacity 3¼″.

Send for a complete description.

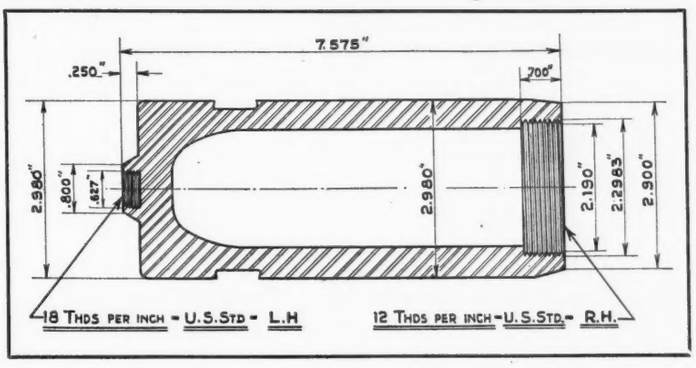
Swind Machinery Co.
Widener Building Philadelphia, Pa.



Read This Letter About

SMALLEY-GENERAL THREAD MILLERS

The following is part of a letter from the Spencer Engineering Company, Toledo, Ohio:—



"We had these machines working on a contract for the United States Government for 3" steel shells. We maintained a production of 54 shells per machine hour, cutting a 2¼" thread, 12 pitch, U. S. Standard; also 84 shells per machine hour, cutting a ⅝" thread, 18 pitch, U. S. Standard. Scrap was practically nil, owing to the accuracy with which your machines perform. Upkeep of hobs was very small. We have cut as many as 5000 threads with one hob. This would be impossible to do with taps. These machines are still running in our plant, and have not given us one minute's trouble. It does not take experienced men to run them."

What better recommendation could a machine receive? Specifiations upon request.

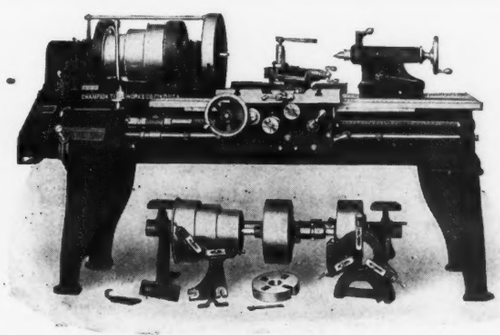
SMALLEY-GENERAL COMPANY, Inc.
BAY CITY MICHIGAN

CHAMPION

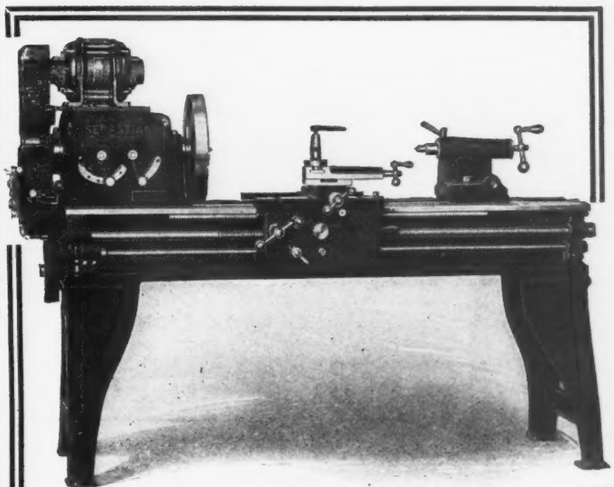
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Machinery Manufacturers are Invited To Co-operate

Does the idea of a *permanent* exhibit in the very heart of New York, with its sales possibilities, and in co-operation with other manufacturers in the same field, appeal to your sound judgment? Many machine tool builders are of the opinion that this project will give a distinct advantage to the concerns taking part in it.

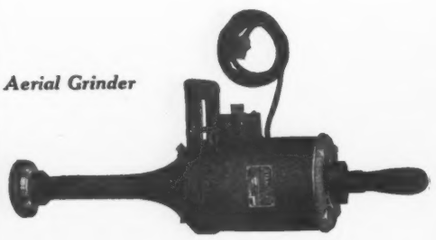
The plan does not contemplate a brief exhibit of any one product or class of products; but is to provide for the continuous display, in action if advisable, of machines and tools of all kinds. It is to provide for a permanent installation of machine tools, with demonstrators, etc. It is a big plan, developed by men who have made successes of similar plans, and is bound to succeed with the proper co-operation.

The place—Grand Central Palace. Space—50,000 square feet. Power, light, heat, etc. Ideal location—for the development of exports as well as domestic sales.

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For Grinding Those Heavy Castings—

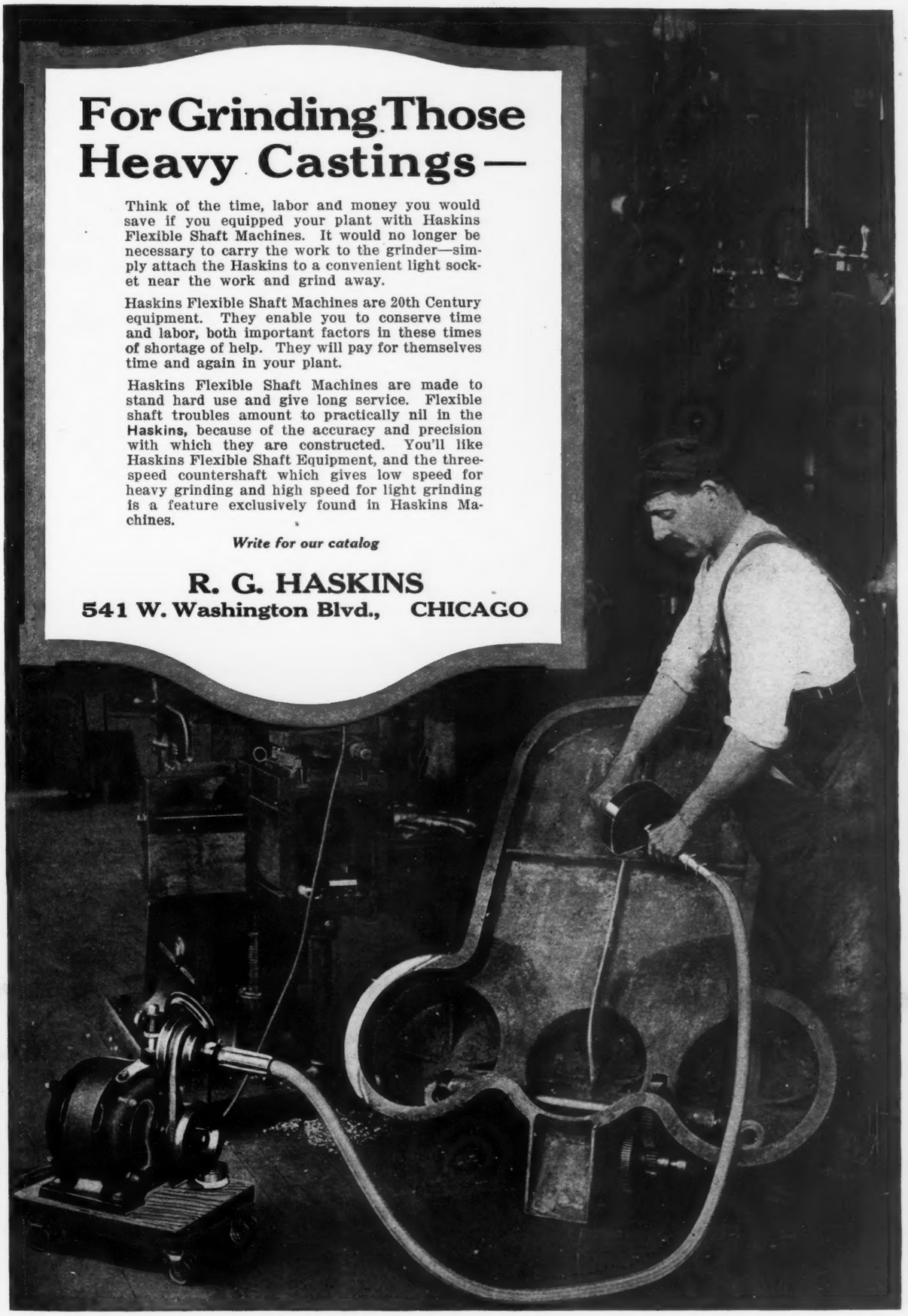
Think of the time, labor and money you would save if you equipped your plant with Haskins Flexible Shaft Machines. It would no longer be necessary to carry the work to the grinder—simply attach the Haskins to a convenient light socket near the work and grind away.

Haskins Flexible Shaft Machines are 20th Century equipment. They enable you to conserve time and labor, both important factors in these times of shortage of help. They will pay for themselves time and again in your plant.

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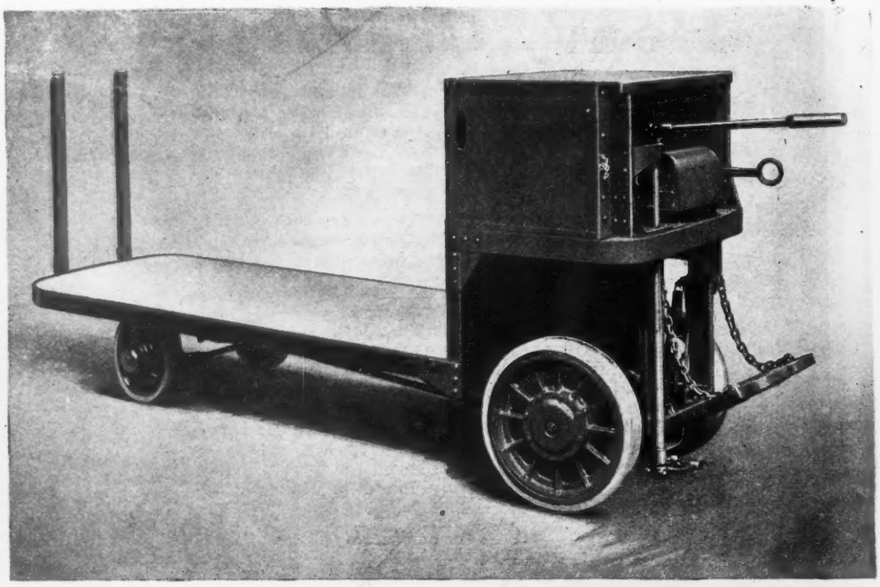


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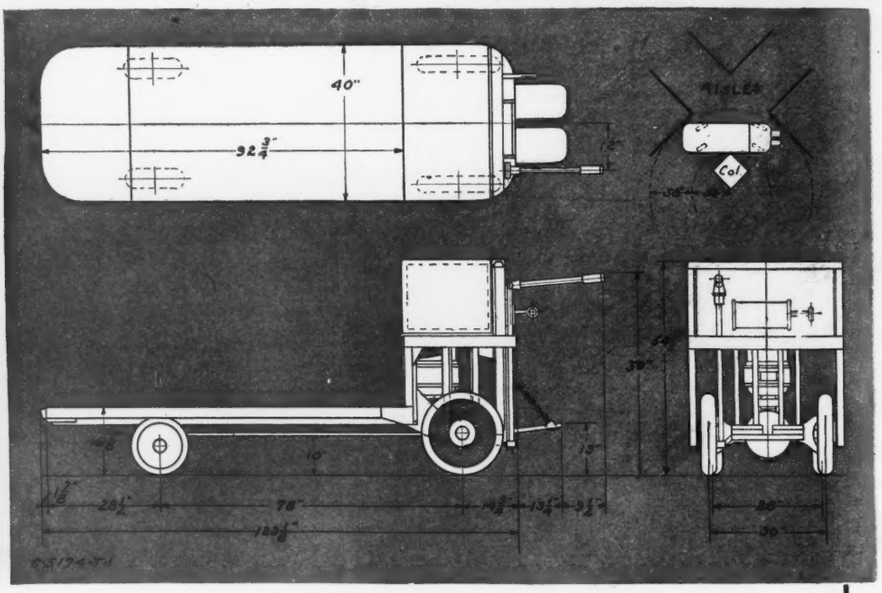












TYPE WB TRUCK—SPECIFICATIONS

Four-Wheel Steer; Two-Wheel Drive. Motor Direct Connected to Worm on Full Floating Axle. Brake Between Motor and Four-Pinion Bevel Differential. Battery over Drive Wheels Fully Assembled and Wired in One Removable Box.

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Speeds—Three in Either Direction.
Brake—Independently Foot Operated, External Contracting.
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Wheels—Drive, Spoked, Extra Large, Demountable.
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Steering Pins—Hardened and Ground; Rigid in Yokes.
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TIMES HAVE CHANGED

"Cleaning Up" Means Something in This Shop



MEECO
Metal Equipment For Shop And Factory

No. 5H Bowls in Battery



Fig. 106

Made in double and single batteries—arranged for hot and cold or one temperature water. Our line also includes: Metal Stock and Pattern Storage Racks, Metal Shelving, Metal Cabinets, Vault Fixtures, Soda Kettles (40 and 60 gallons), Metal Stools and Chairs, Water Mixers, Work Benches, Bench Legs, Full line of Plumbing Fixtures, etc. Send for complete catalog.

An old time machinist will tell you that in his 'prentice days, provision for "cleaning up" was a bucket half full of cold water kept under his machine—that he stored his overalls on his stool and hung his coat on a hook in the shop.

How times have changed—individual enamel basins, an abundance of hot water and separate fire-proof lockers give "cleaning up" a real significance in the shop where this picture was taken. Ice cooled, bubbling drinking fountains replace the pail and dipper of by-gone days and sanitary metal furniture the dirt grimed bench and rack.

Sanitary, up-to-date shop equipment is our specialty. Send for circulars.

Ice Cooled. Attach to Municipal Supply



Fig. 604

Supplies 150 people; holds 75 pounds of ice, 15½ coils ½ inch seamless brass tubing. Attaches to municipal water supply.

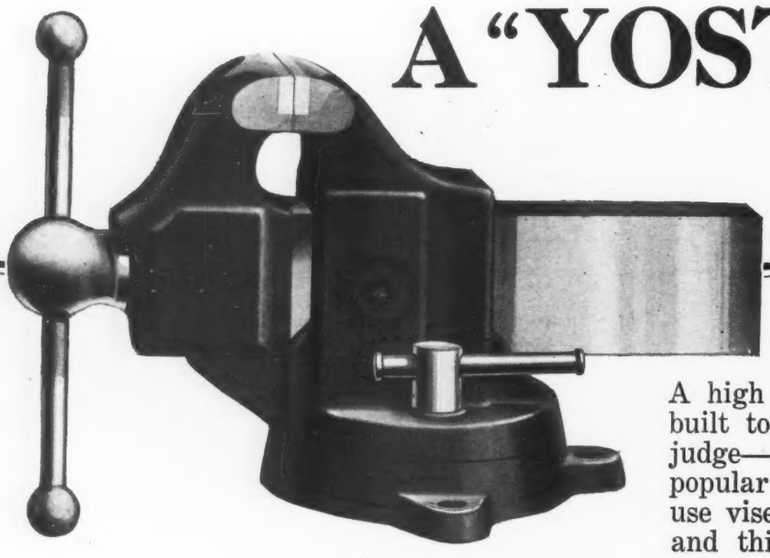
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Office and Show Rooms **Boston, Massachusetts**

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Swivel Base



A high grade machinists' vise, built to suit that most critical judge—the skilled mechanic. A popular vise with the men who use vises in their daily work—and this we consider the best recommendation that any tool can earn.

There's a big family of Yost Vises—vises for every purpose—every one designed and built with the proper distribution of carefully selected metal — every vise guaranteed to give satisfactory service under all working conditions.

Buy Yost Vises and you'll make a good investment.

Catalog No. 8 lists full line—send for a copy.

YOST MANUFACTURING CO., Meadville, Pa.

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"The Handy Tool"

This Vise is designed for holding work on a drill table. It is similar in construction to the Skinner Planer Chuck, but more portable and convenient for use on a drill. It can also be used to advantage on Planers, Shapers, Milling Machines, etc.



BODY—Carefully machined and highly finished casting, provided with lugs on side so vise may be used at right angles.

JAWS—Of good proportion with steel faces. "V" grooves can be cut in these jaws for holding round work. Instant adjustment of jaws can be made from 0 to greatest capacity. Either straight or taper work can be held.

SCREWS—Set screw and holding strip of crucible steel, and set screws and nuts hardened.

WRENCH—A case hardened forged steel wrench is furnished with each vise.

FITTING—Bolted to drill, planer, miller or shaper by ears at both ends of vise. Vise also has flange on all sides for clamping.

We will be glad to send a Catalog illustrating our entire line of Lathe, Drill and Planer Chucks, upon request.

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FACTORY AND MAIN OFFICE: NEW BRITAIN, CONN., U.S.A.

Three Simple Parts Mean Greatest Strength



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Has Unquestioned Lasting-Power

The head, bar shoulder, and handle-frame are forged solid of one piece, then case-hardened to insure uniform strength and to overcome the weak point found in ordinary screw wrenches, namely, the likelihood of breaking at a point on the bar opposite the knurled thumb-screw.

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Typical and true—the know-how of 68 years' experience, the famous "Pittsburgh Bevel" and other distinctive features insure lasting results from Matthews Steel Stamps and Lettering Dies. Catalog lists full line.



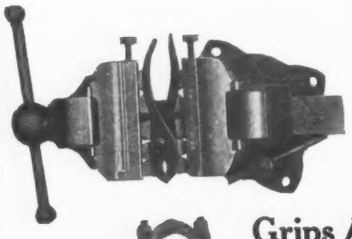
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This great little improvement is used by many of the largest concerns in the world. Won't *you* try it? It will save your work and your time.

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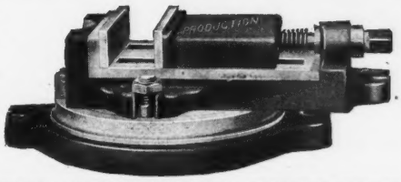
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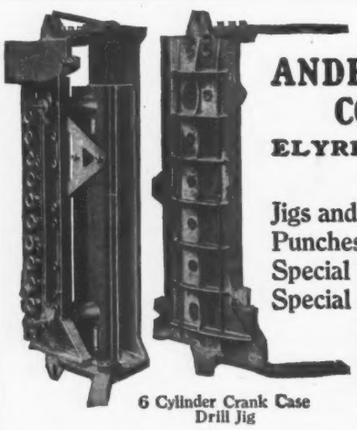
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6 Cylinder Crank Case Drill Jig

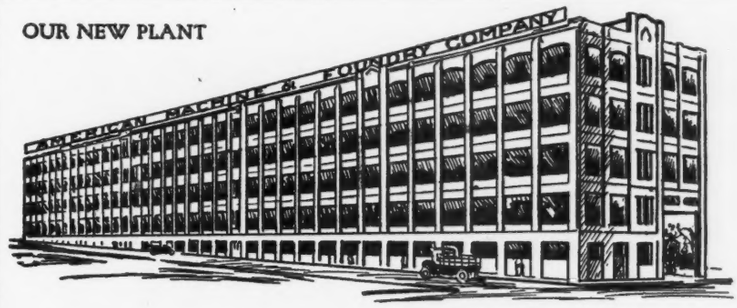
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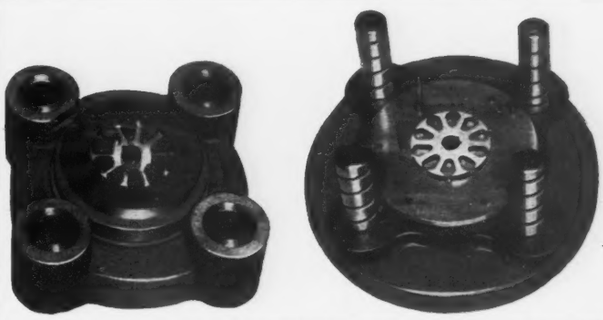
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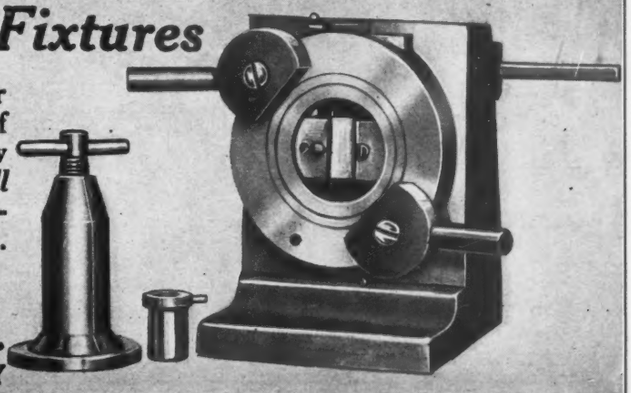
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We shall make this device in connection with the Thread Gauges and Thread Gauge Measuring Devices to which we confine our efforts.

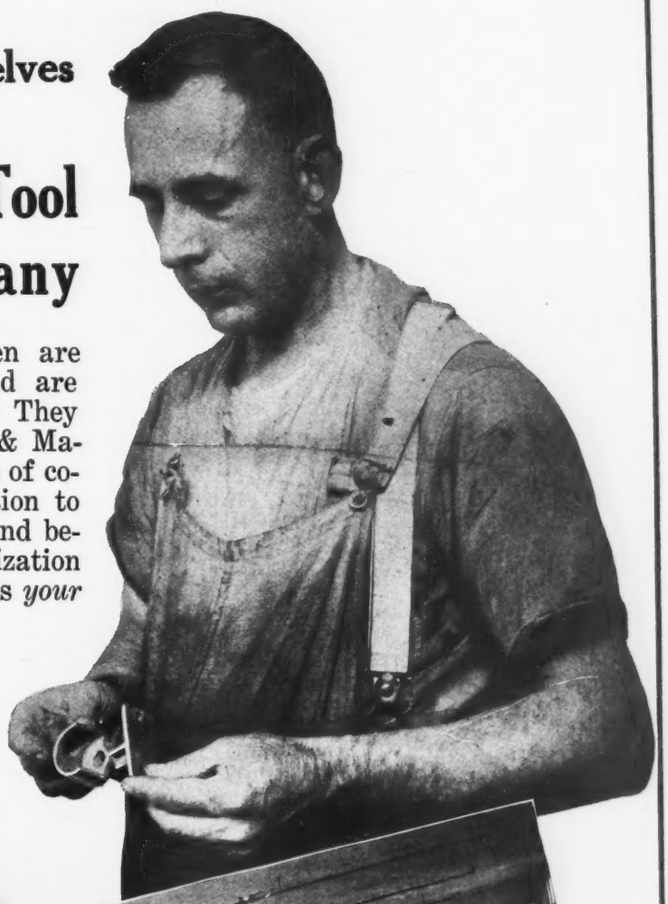
THE SHEFFIELD MACHINE & TOOL CO.
DAYTON, OHIO, U. S. A.

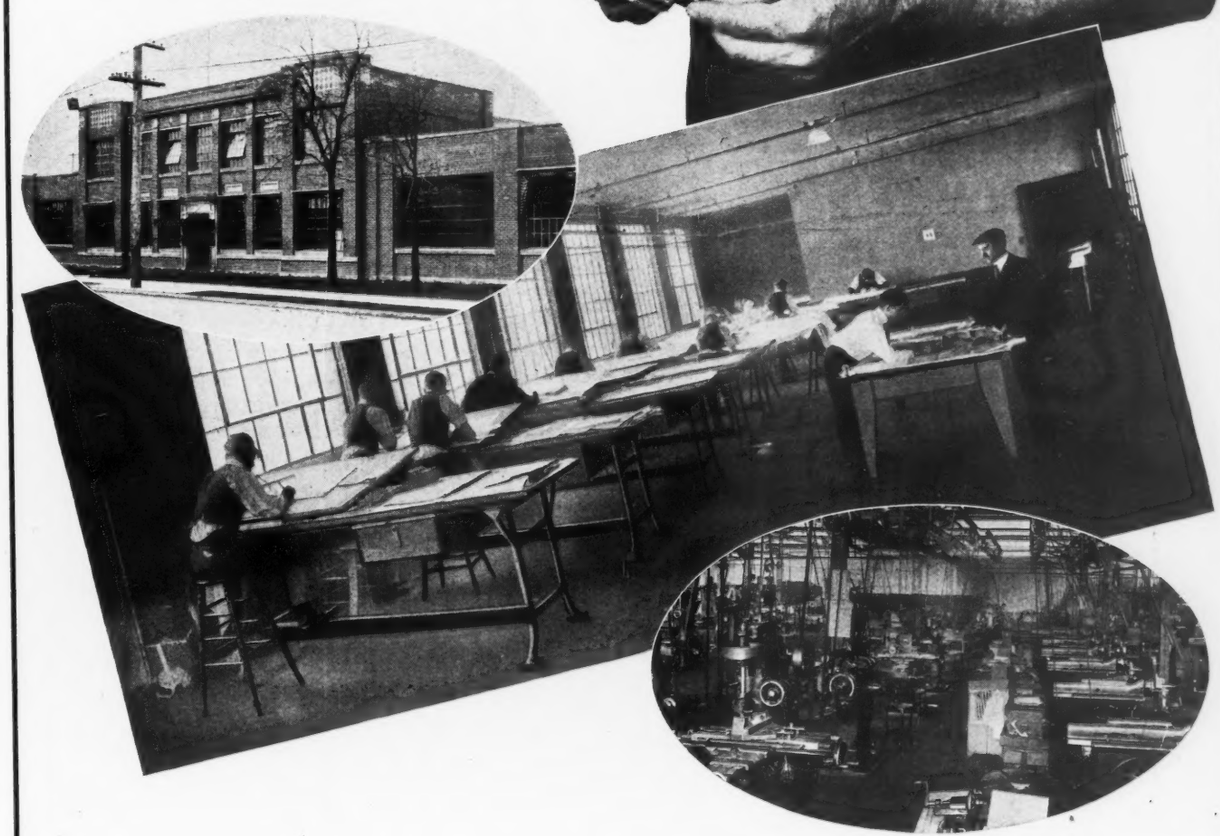
What the Men Themselves Think About

The Columbus Die, Tool & Machine Company

Columbus Die, Tool & Machine men are hired for their particular skill, and are specialists in their respective callings. They are taught the Columbus Die, Tool & Machine organization system—the value of co-operation—the importance of attention to detail. The fact that they remain and become important parts of the organization proves they like their work—which is *your* work. The result is

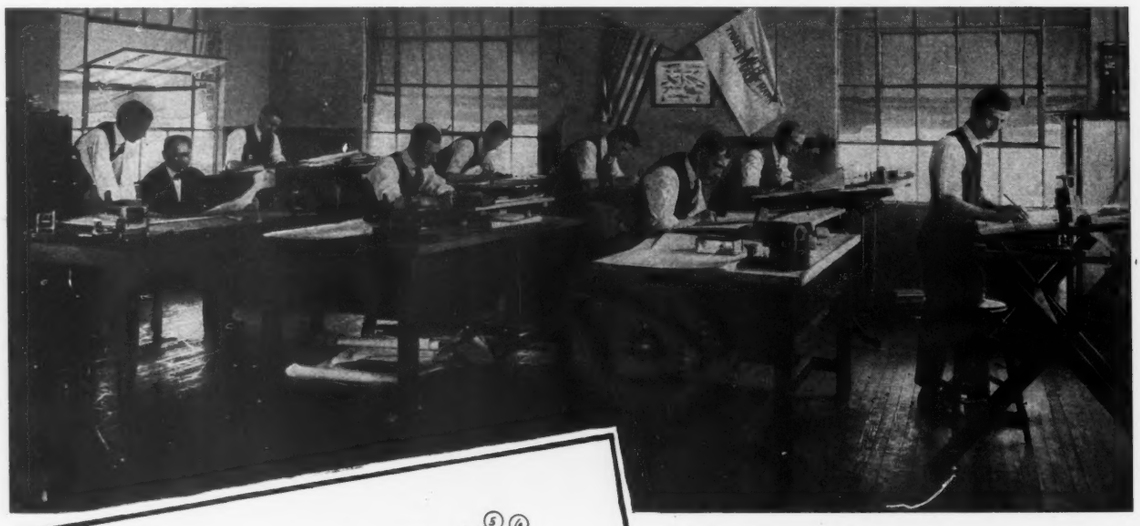
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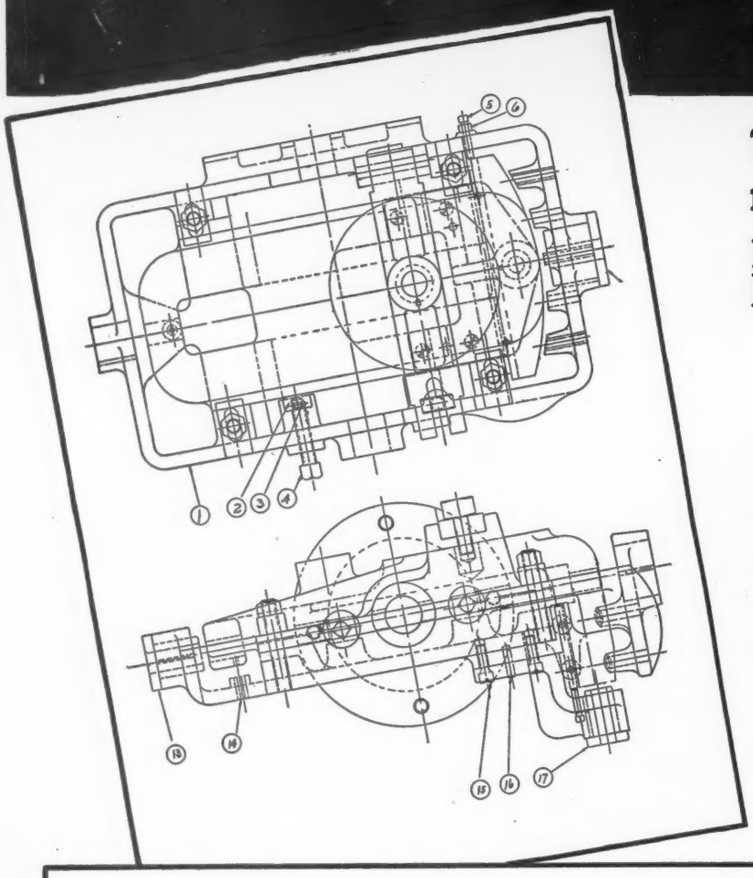




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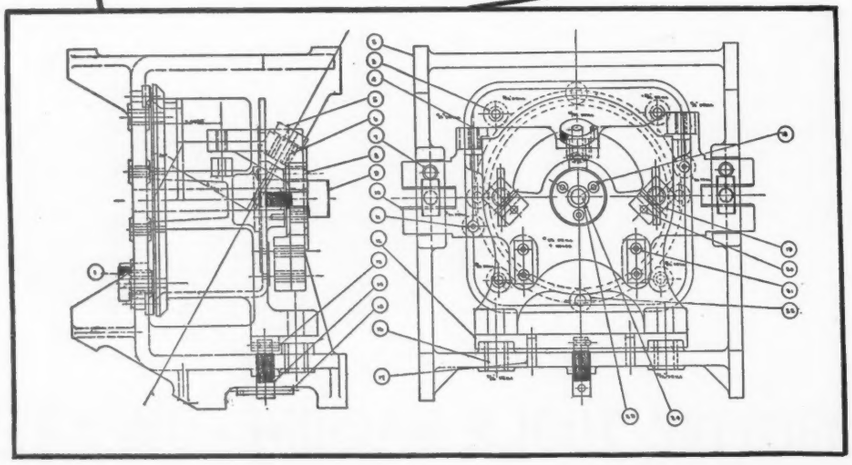
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URBANA TOOL & DIE COMPANY

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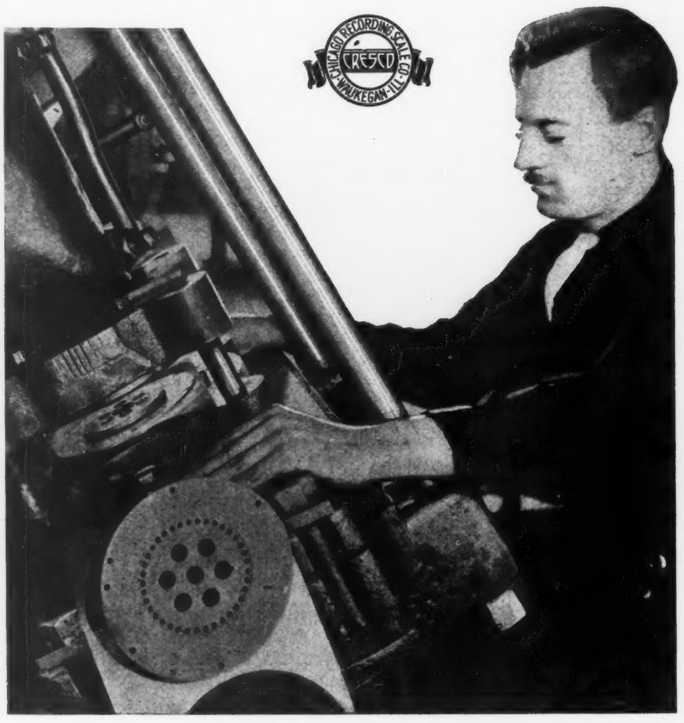
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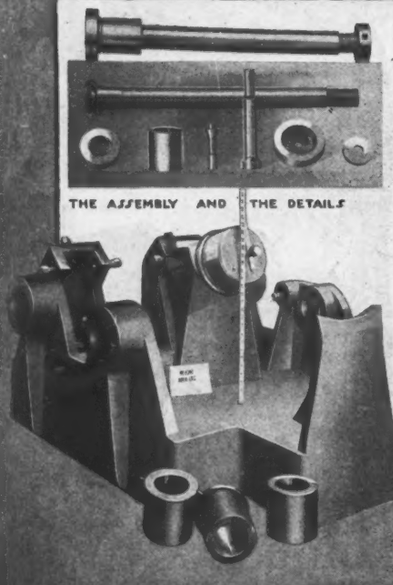
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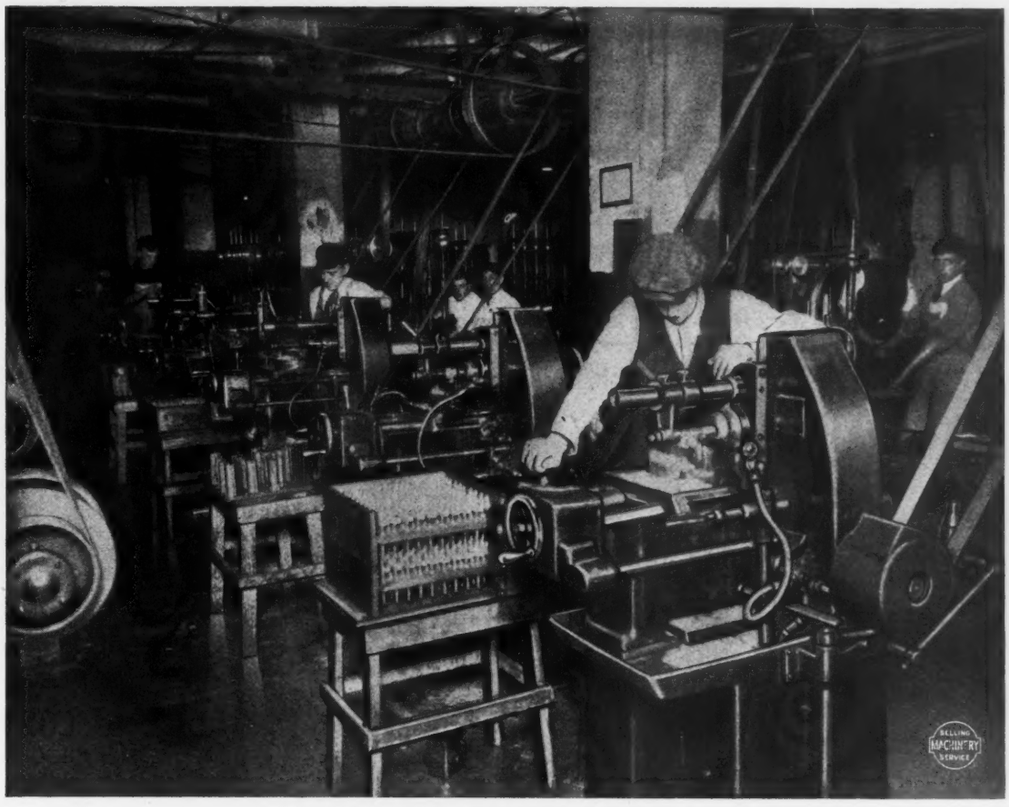


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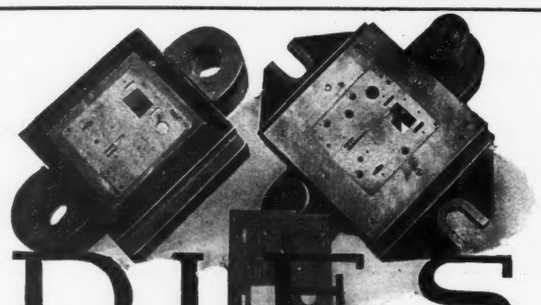
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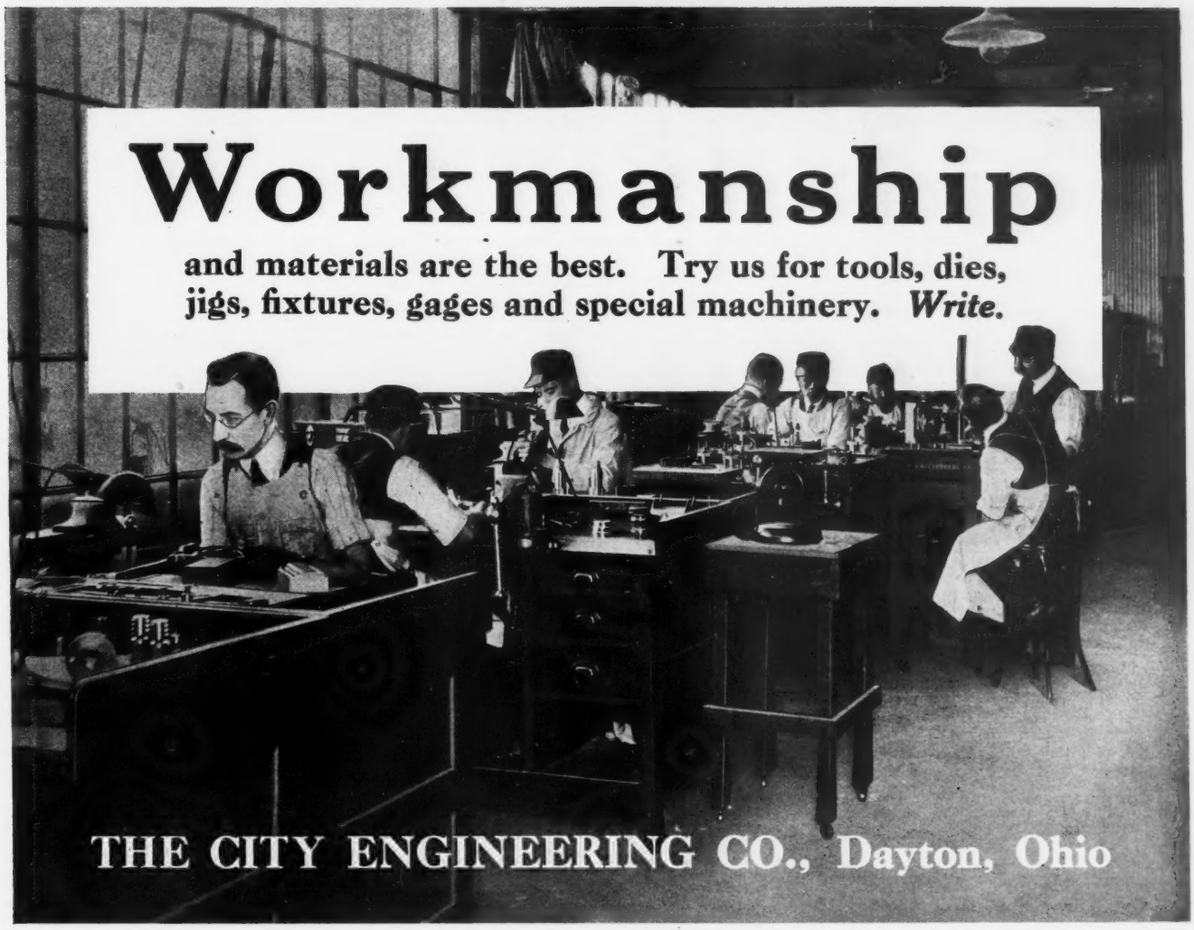
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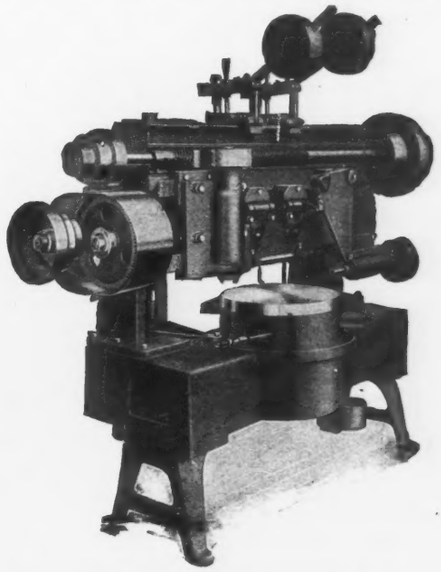
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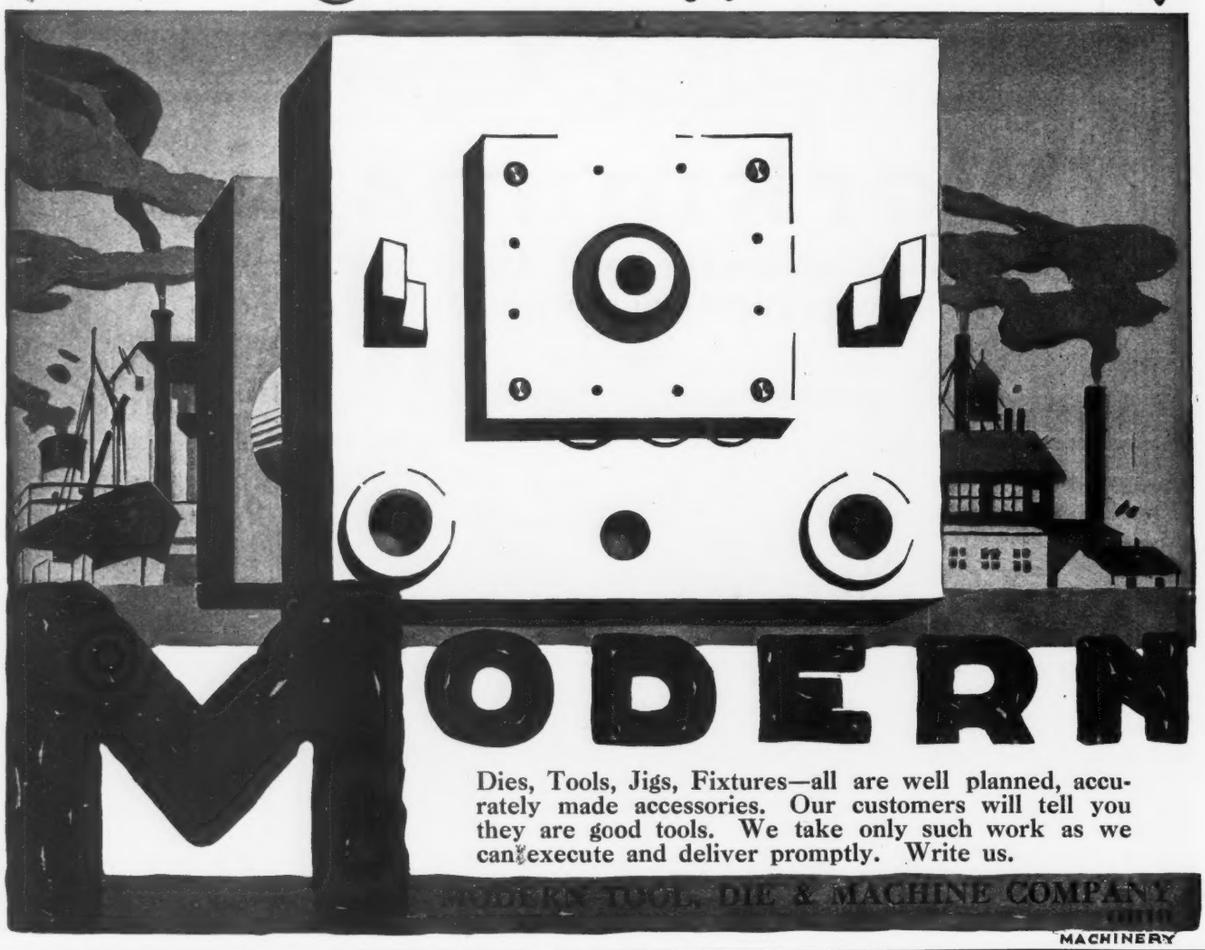
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60 "	30 "	2,000
72 "	66 "	5,000
96 "	88 "	10,000

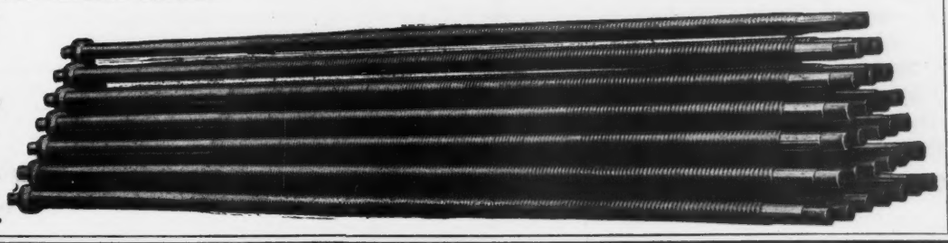
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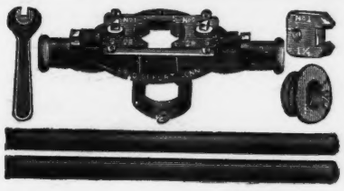
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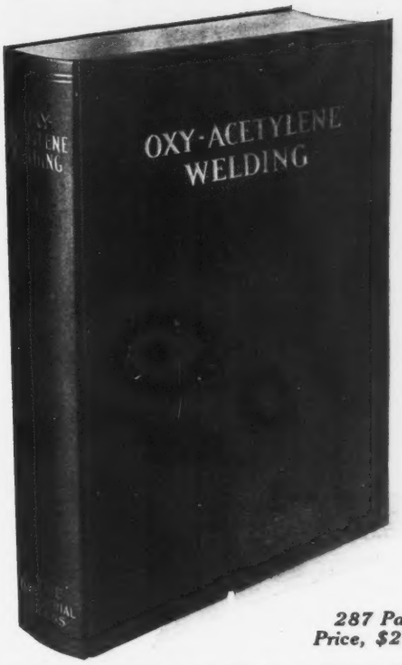
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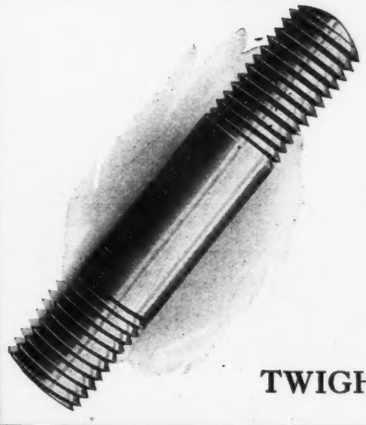
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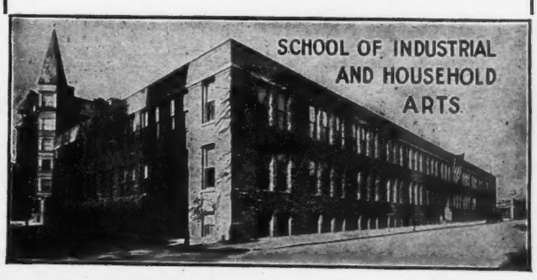
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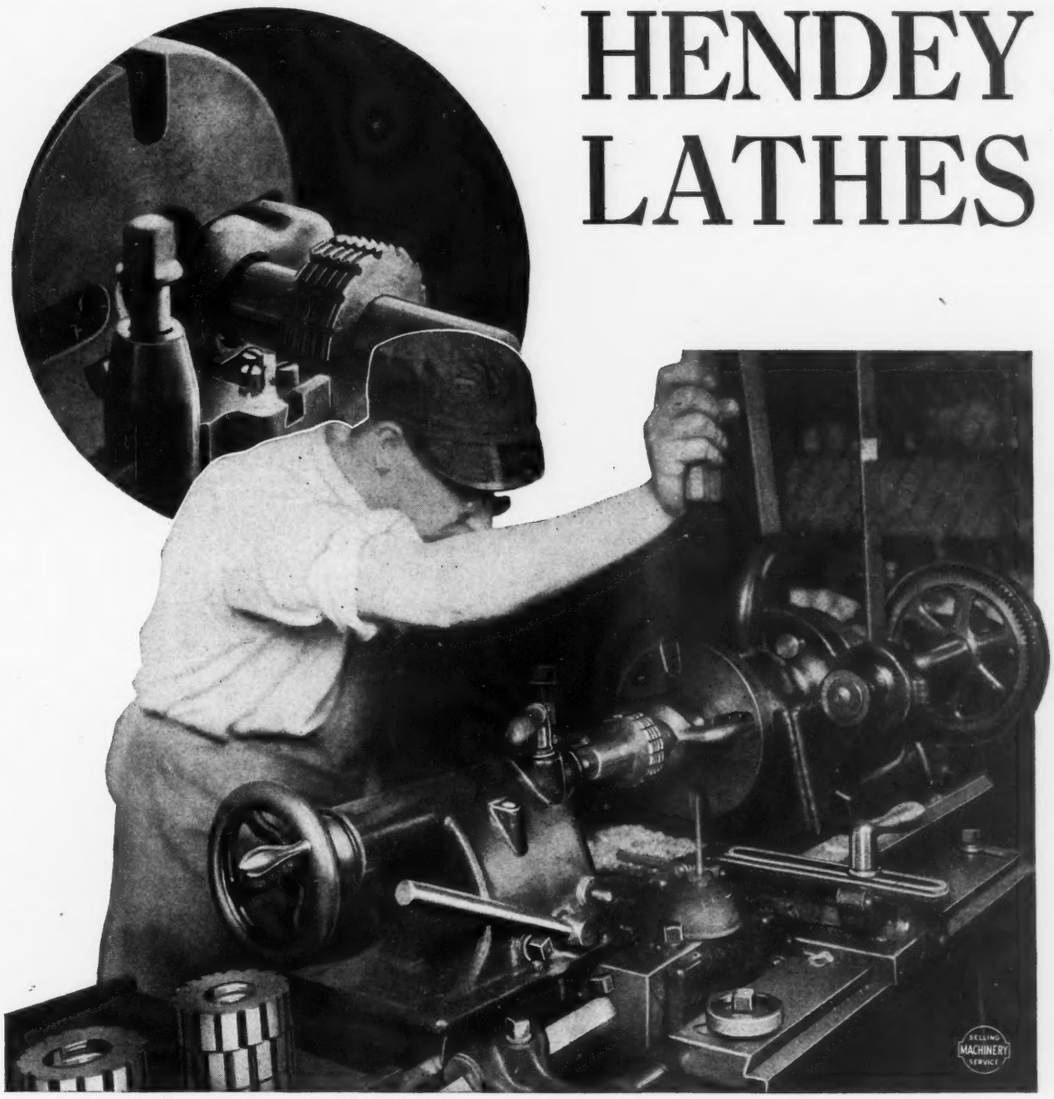
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Bullard Mch. Tool Co., Bridgeport, Conn.
Cincinnati Planer Co., Cincinnati, O.
Colburn Mch. Tool Co., Franklin, Pa.
Gisholt Mch. Co., Madison, Wis.
Niles-Bement-Pond Co., 111 Broadway, New York.
Sellers & Co., Inc., Wm., Philadelphia, Pa.
Springfield Mch. Tool Co., 631 Southern Ave., Springfield, O.

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Armstrong Bros. Tool Co., 313 N. Francisco Ave., Chicago, Ill.
Beaman & Smith Co., Providence, R. I.
Giddings & Lewis Mfg. Co., Fond du Lac, Wis.
Gisholt Mch. Co., Madison, Wis.
Lovejoy Tool Co., Inc., Springfield, Vt.
Pedrick Tool & Mch. Co., 3639 N. Lawrence St., Philadelphia, Pa.
Ready Tool Co., 650 Railroad Ave., Bridgeport, Conn.
Wilcox Motor & Mfg. Co., Saginaw, Mich.

Boring, Drilling and Milling Machines, Horizontal
Beaman & Smith Co., Providence, R. I.
Cleveland Mch. Tool Co., Cleveland, O.
Defiance Machine Works, Defiance, O.
Giddings & Lewis Mfg. Co., Fond du Lac, Wis.
Gisholt Mch. Co., Madison, Wis.
Lambert Machine & Engineering Co., Cleveland, O.
Landis Machine Co., Inc., Waynesboro, Pa.
Lucas Mch. Tool Co., Cleveland, O.
Newton Mch. Tool Works, Inc., 23rd and Vine Sts., Philadelphia, Pa.
Niles-Bement-Pond Co., 111 Broadway, New York.
Pawling & Harnischfeger Co., Milwaukee, Wis.
Rockford Drilling Mch. Co., Rockford, Ill.
Sellers & Co., Inc., Wm., Philadelphia, Pa.
Universal Boring Mch. Co., Hudson, Mass.

Boring Heads, Offset
Marvin & Casler Co., Canastota, N. Y.
Porter-Cable Mch. Co., Syracuse, N. Y.
Waterston, J. M., Detroit, Mich.

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Armstrong Bros. Tool Co., 313 N. Francisco Ave., Chicago, Ill.
Kelly Reamer Co., Cleveland, O.
Lovejoy Tool Co., Inc., Springfield, Vt.
Maxwell-Hutchcroft Co., Cleveland, O.
Morse Twist Drill & Machine Co., New Bedford, Mass.
O. K. Tool Holder Co., Shelton, Conn.
Ready Tool Co., 650 Railroad Ave., Bridgeport, Conn.
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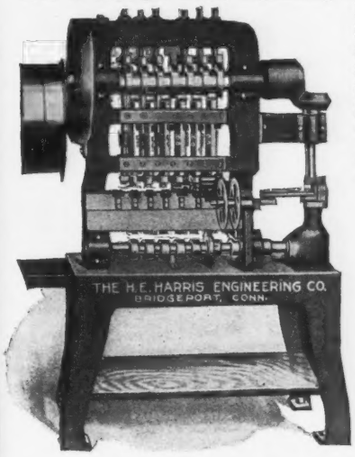
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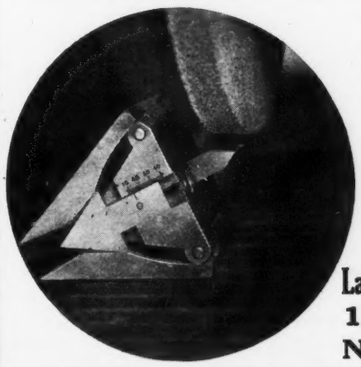


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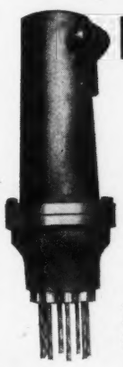
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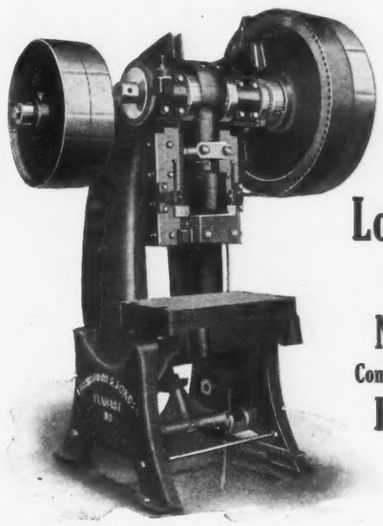
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Porter-Cable Mch. Co., Syracuse, N. Y.
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Newton Mch. Tool Works, Inc., 23rd and Vine Sts., Philadelphia, Pa.

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New Britain Mch. Co., New Britain, Conn.
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Chucking Machines, Multiple Spindle, Automatic
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Cushman Chuck Co., Hartford, Conn.
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McCrosky Reamer Co., Meadville, Pa.
Newman Mfg. Co., Cincinnati, O.
Oneida National Chuck Co., Oneida, N. Y.
Pratt Chuck Co., Frankfort, N. Y.
Rivett Lathe & Grinder Co., Brighton District, Boston, Mass.
Skinner Chuck Co., New Britain, Conn.
Terkelsen & Wennberg, Boston, Mass.
Thomas Elevator Co., 22 S. Hoyne Ave., Chicago, Ill.
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Persons-Arter Mch. Co., Worcester, Mass.
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Cushman Chuck Co., Hartford, Conn.
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Conway & Co., Cincinnati, O.
Cresson-Morris Co., Philadelphia, Pa.
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Scully-Jones & Co., 647 Railway Exchange, Chicago, Ill.

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Pratt & Whitney Co., Hartford, Conn.
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Collets, Spring
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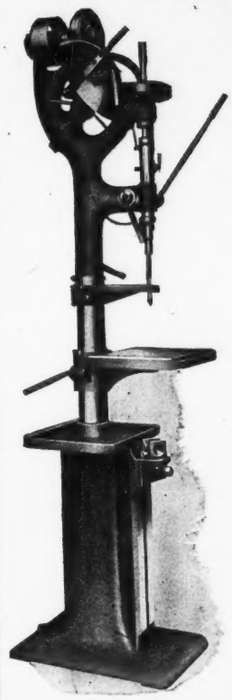
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Curtis Pneumatic Mchy. Co., 1568 Kienlen Ave., St. Louis, Mo.
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Taft-Peirce Co., Woonsocket, R. I.
Taylor-Shantz Co., Rochester, N. Y.
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Conveyers, Grab Bucket
Northern Engineering Works, Detroit, Mich.

Conveyers, Gravity
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Link-Belt Co., Chicago, Ill.

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National Tool Co., Cleveland, O.
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Standard Tool Co., Cleveland, O.
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Cresson-Morris Co., Philadelphia, Pa.
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Davis Mch. Tool Co., Inc., Rochester, N. Y.
Diamond Mch. Co., Providence, R. I.
Edgemont Mch. Co., 2700 National Ave., Dayton, O.
Garvin Machine Co., Spring and Varick Sts., New York.
Gisholt Machine Co., Madison, Wis.
Hilliard Clutch & Mchy. Co., Elmira, N. Y.
Hyatt Roller Bearing Co., Metropolitan Tower, New York.
Jones Foundry & Mch. Co., W. A., 4409 W. 12th St., Chicago, Ill.
LeBlond Mch. Tool Co., R. K., Cincinnati, O.

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Grant Mfg. & Mch. Co., N. W. Station, Bridgeport, Conn.
Starrett Co. L. S., Athol, Mass.
Veeder Mfg. Co., 39 Sargeant St., Hartford, Conn.

Counting Machines
National Scale Co., Chicopee Falls, Mass.
Veeder Mfg. Co., 39 Sargeant St., Hartford, Conn.

Couplers, Hose
Greene, Tweed & Co., 109 Duane St., New York.
Ingersoll-Rand Co., 11 Broadway, New York.

Couplings, Cut-off, Friction
Johnson, Carlyle, Mach. Co., Manchester, Conn.

Couplings, Flexible Shaft
Boston Gear Works, Norfolk Downs, Mass.
Caldwell & Son Co., H. W., 17th St. and Western Ave., Chicago, Ill.
Cooper Flexible Transmission Co., Inc., Brooklyn, N. Y.
Cresson-Morris Co., Philadelphia, Pa.
Smith-Serrell Co., Inc., 144 Cedar St., New York.
Wood, Sons Co., T. B., Chambersburg, Pa.

Couplings, Pipe
Dart Mfg. Co., E. M., Providence, R. I.
New Haven Screw Co., New Haven, Conn.

Couplings, Shaft
Brown Co., A. & F., 79 Barclay St., New York.
Brown Engineering Co., 133 N. 3rd St., Reading, Pa.
Caldwell & Son Co., H. W., 17th St. and Western Ave., Chicago, Ill.
Cresson-Morris Co., Philadelphia, Pa.
Hilliard Clutch & Mchy. Co., Elmira, N. Y.
Link-Belt Company, Chicago, Ill.
Moore & White Co., 2707-2737 N. 15th St., Philadelphia, Pa.
Nicholson & Co., W. H., 112 Oregon St., Wilkes-Barre, Pa.
Royersford Foundry & Mch. Co., 54 N. 5th St., Philadelphia, Pa.
Sellers & Co., Inc., Wm., Philadelphia, Pa.
Smith-Serrell Co., Inc., 144 Cedar St., New York.
Wood, Sons & Co., T. B., Chambersburg, Pa.

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Box & Co., Inc., Alfred, Philadelphia, Pa.
Chisholm-Moore Mfg. Co., Cleveland, O.
Curtis Pneumatic Mchy. Co., 1568 Kienlen Ave., St. Louis, Mo.
Harrington, Son & Co., Inc., Edwin, Philadelphia, Pa.
Manning, Maxwell & Moore, Inc., 119 W. 40th St., New York.
Niles-Bement-Pond Co., 111 Broadway, New York.
Northern Engineering Works, Detroit, Mich.
Q M S Co., 1763 Elston Ave., Chicago, Ill.
Shaw Electric Crane Co., Muskegon, Mich.
Shepard Electric Crane & Hoist Co., Montour Falls, N. Y.
Vandyck Churchill Co., 149 Broadway, New York.
Wright Mfg. Co., Lisbon, O.
Yale & Towne Mfg. Co., 9 E. 40th St., New York.

Cranes, Electric Traveling
Biggs-Watterson Co., Cleveland, O.
Box & Co., Inc., Alfred, Philadelphia, Pa.
Manning, Maxwell & Moore, Inc., 119 W. 40th St., New York.
Milwaukee Electric Crane Co., Inc., Milwaukee, Wis.
Northern Engineering Works, Detroit, Mich.
Pawling & Harnischfeger Co., Milwaukee, Wis.
Payne, N. B., 25 Church St., New York.
Shaw Electric Crane Co., Muskegon, Mich.

Cranes, Electric Truck
General Electric Co., Schenectady, N. Y.

Cranes, Hand Traveling
Manning, Maxwell & Moore, Inc., 119 W. 40th St., New York.
Shaw Electric Crane Co., Muskegon, Mich.

Cranes, Locomotive
Curtiss-Willis Co., Inc., 30 Church St., New York.
Link-Belt Company, Chicago, Ill.

Cranes, Portable
Canton Fdry. & Mch. Co., Canton, O.

Crank Pin Turning Machines
American Tool Works Co., Cincinnati, O.
LeBlond Mch. Tool Co., R. K., Cincinnati, O.
Lodge & Shipley Mch. Tool Co., Cincinnati, O.
Niles-Bement-Pond Co., 111 Broadway, New York.
Pedrick Tool & Mch. Co., 3639 N. Lawrence St., Philadelphia, Pa.

Crucibles
Dixon Crucible Co., Joseph, Jersey City, N. J.

Cutters, Milling
Adams Co., Dubuque, Iowa.
Advance Tool Co., Cincinnati, O.
Barber-Colman Co., Rockford, Ill.
Becker Milling Machine Co., Hyde Park, Mass.
Brown & Sharpe Mfg. Co., Providence, R. I.
Cleveland Milling Machine Co., Cleveland, O.
Cleveland Twist Drill Co., Cleveland, O.
Columbus Die, Tool & Mch. Co., Columbus, O.
Cowles Tool Co., Cleveland, O.
Detroit Twist Drill Co., Detroit, Mich.
Genesee Mfg. Co., Rochester, N. Y.
Glenzer Co., J. C., Detroit, Mich.
Goddard Tool Co., Chicago, Ill.
Gould & Eberhardt, Newark, N. J.
Harris Engineering Co., H. E., Bridgeport, Conn.
Illinois Tool Works, Chicago, Ill.
Ingersoll Milling Machine Co., Rockford, Ill.
Kearney & Trecker Co., Milwaukee, Wis.
Krasberg Mfg. Co., 412 Orleans St., Chicago, Ill.
Morse Twist Drill & Machine Co., New Bedford, Mass.
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National Twist Drill & Tool Co., Detroit, Mich.
Newark Gear Cutting Mch. Co., Newark, N. J.
O. K. Tool Holder Co., Shelton, Conn.
Pratt & Whitney Co., Hartford, Conn.
Standard Tool Co., Cleveland, O.
Union Twist Drill Co., Athol, Mass.
Whitney Mfg. Co., Hartford, Conn.
Windau Tool Co., Cleveland, O.

Cutting Compound
See Compound, Cutting, Grinding, etc.

Cutting-off Machines, Abrasive Wheel
Armstrong Bros. Tool Co., 313 N. Francisco Ave., Chicago, Ill.
Greenfield Tap & Die Corp., Greenfield, Mass.
Peter Bros. Mfg. Co., Algonquin, Ill.

Cutting-off Machines, Cold Saw
See Saws, Rotary Machines.

Cutting-Off Machines, Rotary
Brown & Sharpe Mfg. Co., Providence, R. I.
Curtis & Curtis Co., 8 Garden St., Bridgeport, Conn.
Davis Mch. Tool Co., Inc., Rochester, N. Y.
Etna Mch. Co., Toledo, O.
Fawcus Mch. Co., Pittsburgh, Pa.
Hurlbut, Rogers Mchy. Co., So. Sudbury, Mass.
Modern Mch. Tool Co., Jackson, Mich.
Oster Mfg. Co., Cleveland, O.
Treadwell Engineering Co., Easton, Pa.

Cutting-Off Tools
Armstrong Bros. Tool Co., 313 N. Francisco Ave., Chicago, Ill.
Goodell-Pratt Co., Greenfield, Mass.
O. K. Tool Holder Co., Shelton, Conn.
Pratt & Whitney Co., Hartford, Conn.
Ready Tool Co., 650 Railroad Ave., Bridgeport, Conn.
Western Tool & Mfg. Co., Springfield, Mass.

Cyclometers
Veeder Mfg. Co., 38 Sargeant St., Hartford, Conn.

Cylinder Borers
See Boring and Drilling Machines, Vertical.
Beaman & Smith Co., Providence, R. I.
Defiance Machine Works, Defiance, O.

Cylinder Boring Machines, Portable
Pedrick Tool & Mch. Co., 3639 N. Lawrence St., Philadelphia, Pa.

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D & W Fuse Co., Providence, R. I.
Heald Mch. Co., Worcester, Mass.
Walker Co., O. S., Worcester, Mass.

Diamonds, Bortz and Carbon
Francis & Co., Hartford, Conn.

Diamond Tools
Francis & Co., Hartford, Conn.

Die Blocks
Dyson & Sons, Jos., Cleveland, O.

Die Castings
See Castings, Die or Die-molded.

Die Sinking Machines
Jackson Mch. Tool Co., Jackson, Mich.
Pratt & Whitney Co., Hartford, Conn.
Walcott Lathe Co., Jackson, Mich.

Die Stocks
See Stocks, Die and Taps and Dies.

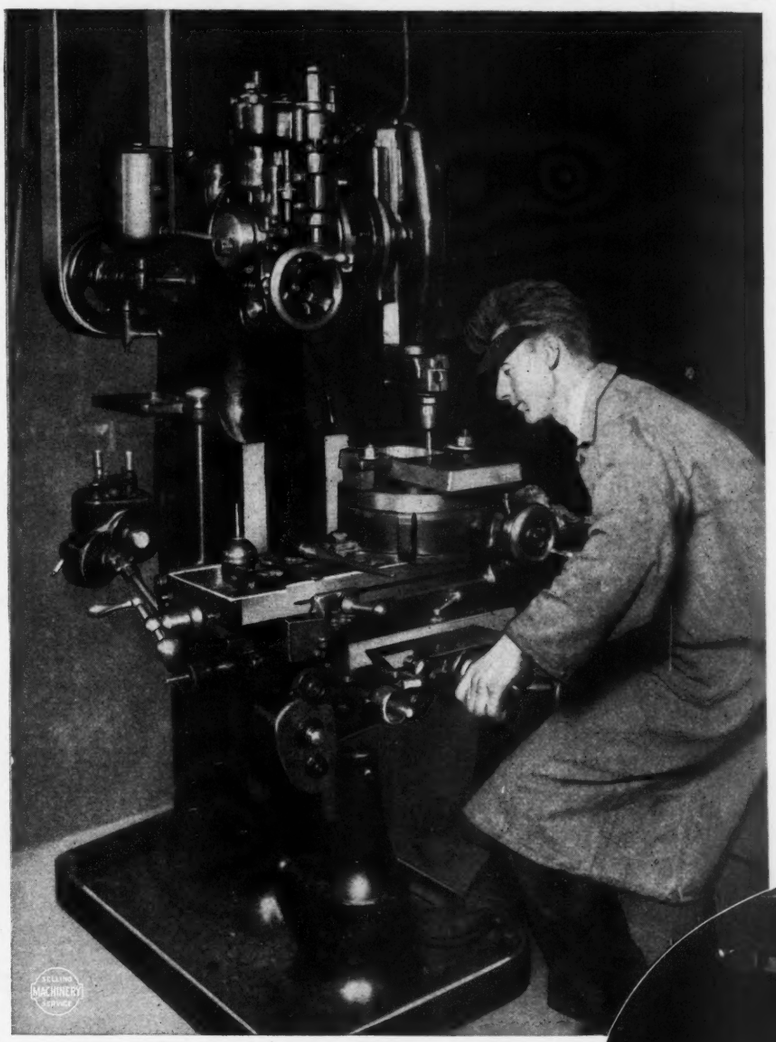
Dies
Bay State Tap & Die Co., Mansfield, Mass.
Brubaker & Bros., W. L., 50 Church St., New York.
Butterfield & Co., Derby Line, Vt.
Card Mfg. Co., S. W., Mansfield, Mass.
Carpenter Tap & Die Co., J. M., Pawtucket, R. I.
Geometric Tool Co., New Haven, Conn.
Greenfield Tap & Die Corp., Greenfield, Mass.
Hammacher, Schlemmer & Co., 4th Ave. and 13th St., New York.
Hardinge Bros. Co., Inc., Berteau and Ravenswood Aves., Chicago, Ill.
Harris Engineering Co., H. E., Bridgeport, Conn.
Hart Mfg. Co., E. 20th St. and Marion Ave., Cleveland, O.
Hjorth Lathe & Tool Co., Boston, Mass.
Landis Mch. Co., Inc., Waynesboro, Pa.
Morse Twist Drill & Mch. Co., New Bedford, Mass.
National Acme Co., Cleveland, O.
Oster Mfg. Co., Cleveland, O.
Pratt & Whitney Co., Hartford, Conn.
Reed Mfg. Co., Erie, Pa.
Rogers Works, Inc., John M., Gloucester City, N. J.
Saunders Sons, Inc., D., Yonkers, N. Y.
Standard Tool Co., Cleveland, O.
Walworth Mfg. Co., Boston, Mass.

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Manhattan Mch. & Tool Works, Grand Rapids, Mich.
Matthews & Co., Jas. H., 3946 Forbes Field, Pittsburgh, Pa.
Maute & Sons, J., Buffalo, N. Y.
Noble & Westbrook Mfg. Co., Hartford, Conn.
Schwerdtle Stamp Co., Bridgeport, Conn.

Dies, Sheet Metal, Etc.
Acklin Stamping Co., 1657 Dorr St., Toledo, O.
American Mch. & Foundry Co., 5520 2nd Ave., Brooklyn, N. Y.
American Tool & Mfg. Co., Urbana, O.
Bliss Co., E. W., 17 Adams St., Brooklyn, N. Y.
Bruno Mfg. Co., Buffalo, N. Y.
Columbus Die Tool & Mch. Co., Columbus, O.
Ferracute Mch. Co., Bridgeton, N. J.
Goddard Tool Co., Chicago, Ill.
Harris Engineering Co., H. E., Bridgeport, Conn.
Krasberg Mfg. Co., 536 Lake Shore Drive, Chicago, Ill.
Lansing Stamping & Tool Co., Lansing, Mich.
Manhattan Mch. & Tool Wks., Grand Rapids, Mich.
Marvin Mfg. Co., W. B., Urbana, O.
Maute & Sons, J., Buffalo, N. Y.
Mehl Mch. Tool & Die Co., Roselle, N. J.
Michigan Tool Co., Detroit, Mich.
Modern Tool, Die & Machine Co., Columbus, O.
Moore-Eastwood Mfg. Co., Dayton, O.
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Potter Tool & Mch. Works, S. A., 79 E. 130th St., New York.
Pratt & Whitney Co., Hartford, Conn.
Reliance Die & Stamping Co., 515 N. La Salle St., Chicago, Ill.
Robidoux Mch. Co., 20 Fulton St., New York.
Rockford Metal Specialty Co., Rockford, Ill.
Sloan & Chace Mfg. Co., Ltd., Newark, N. J.
Sundstrom Mfg. Co., 3201 Shields Ave., Chicago, Ill.
Swaine Mfg. Co., F. J., St. Louis, Mo.
Taft-Peirce Mfg. Co., Woonsocket, R. I.
Taylor-Shantz Co., Rochester, N. Y.
Urbana Tool & Die Co., Urbana, O.
Waltham Mch. Works, Waltham, Mass.

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Butterfield & Co., Derby Line, Vt.
Eastern Mch. Screw Corp., New Haven, Conn.
Errington Mechanical Laboratory, 39 Cortlandt St., New York.
Geometric Tool Co., New Haven, Conn.
Greenfield Tap & Die Corp., Greenfield, Mass.
Ideal Tool & Mfg. Co., Beaver Falls, Pa.
Jones & Lamson Mch. Co., Springfield, Vt.
Landis Mch. Co., Inc., Waynesboro, Vt.
Modern Tool Co., 2nd and State Sts., Erie, Pa.
Murchey Mch. & Tool Co., 34 Porter St., Detroit, Mich.
National Acme Co., Cleveland, O.
Pratt & Whitney Co., Hartford, Conn.
Rickert-Shafer Co., Erie, Pa.
Webster & Perks Tool Co., Springfield, O.

Dividing Heads
See Milling Machines, Universal.
Dickow, Fred C., 37 So. Desplaines St., Chicago, Ill.

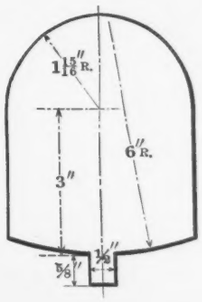


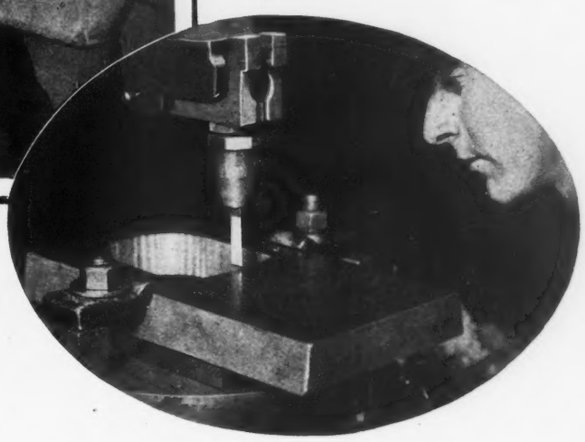
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Nine-tenths of the work done on the Universal Shaper is completed without re-chucking the piece. That is the big Cochrane-Bly advantage and one which appeals to manufacturers as well as toolmakers. The universal heads, compound table, milling spindle and shaper ram that can be operated at any angle, permit a speed in machining the various contours and surfaces of special shaping and milling operations impossible to duplicate by any other means and give it first place among the few real precision tools with universal and productive features. Whether in toolroom or shop, the Cochrane-Bly is an asset when speed, close accuracy and economy must go hand in hand.

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Nelson-Blanck Mfg. Co., Detroit, Mich.
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Sellew Mch. Tool Co., Pawtucket, R. I.

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National Twist Drill & Tool Co., Detroit, Mich.
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Standard Tool Co., Cleveland, O.
Union Twist Drill Co., Athol, Mass.

Drill Speeders
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Peter Bros. Mfg. Co., 135 Railroad Ave., Algonquin, Ill.

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Detroit Tool Co., Detroit, Mich.

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Blomquist-Eck Mch. Co., Cleveland, O.
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Rockford Lathe & Drill Co., Rockford, Ill.
Taylor & Fenn Co., Hartford, Conn.
United States Electrical Tool Co., 6th Ave. and Mt. Hope St., Cincinnati, O.
Winterhoff Tool & Mch. Co., Elkhart, Ind.

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Foote-Burt Co., Cleveland, O.
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Sellers & Co., Inc., Wm., Philadelphia, Pa.

Drilling Machines, Horizontal, Duplex
Garvin Mch. Co., Spring and Varick Sts., New York.
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Harrington, Son & Co., Inc., Edwin, Philadelphia, Pa.
Langelier Mfg. Co., Providence, R. I.
Moline Tool Co., Moline, Ill.
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Defiance Machine Works, Defiance, O.
Detroit Tool Co., Detroit, Mich.
Harrington, Son & Co., Inc., Edwin, Philadelphia, Pa.
Langelier Mfg. Co., Providence, R. I.
Moline Tool Co., Moline, Ill.
National Acme Co., Cleveland, O.

Drilling Machines, Multiple Spindle, Turret
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National Automatic Tool Co., Richmond, Ind.
Newman Mfg. Co., Cincinnati, O.
Turner Mch. Co., Danbury, Conn.

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Barnes Co., W. F. & John, 231 Ruby St., Rockford, Ill.
Barnes Drill Co., Inc., 814 Chestnut St., Rockfodr, Ill
Cincinnati Bickford Tool Co., Oakley, Cincinnati, O.
Cincinnati Pulley Mchy. Co., Cincinnati, O.
Clark Electric Co., Inc., Jas., Jr., Louisville, Ky.
Cleveland Machy. & Supply Co., Cleveland, O.
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Detroit Tool Co., Detroit, Mich.
Foote-Burt Co., Cleveland, O.
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Langelier Mfg. Co., Providence, R. I.
Henry & Wright Mfg. Co., Hartford, Conn.
Leland-Gifford Co., Worcester, Mass.
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National Automatic Tool Co., Richmond, Ind.
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Silver Mfg. Co., Salem, O.
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Superior Mch. Tool Co., Kokomo, Ind.
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Chicago Pneumatic Tool Co., 1060 Fisher Bldg., Chicago, Ill.
Independent Pneumatic Tool Co., Chicago, Ill.
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Cincinnati Electrical Tool Co., Cincinnati, O.
Clark Electric Co., Inc., Jas., Jr., Louisville, Ky.
Errington Mechanical Laboratory, 39 Cortlandt St., New York.
Haskins, R. G., 541 W. Washington Blvd., Chicago, Ill.
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Neil & Smith Electric Tool Co., Cincinnati, O.
Standard Electric Tool Co., Cincinnati, O.
Stow Mfg. Co., Binghamton, N. Y.
United States Electrical Tool Co., 6th Ave. and Mt. Hope St., Cincinnati, O.
Van Dorn Electric Tool Co., Cleveland, O.

Drilling Machines, Radial
American Tool Works Co., Cincinnati, O.
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Carlton Mch. Tool Co., Cincinnati, O.
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Townsend Mfg. Co., H. P., Hartford, Conn.
Taylor & Fenn Co., Hartford, Conn.
Winterhoff Tool & Mch. Co., Elkhart, Ind.

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Buffalo Forge Co., Buffalo, N. Y.
Canedy-Otto Mfg. Co., Chicago, Ill.
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Cincinnati Pulley Mchy. Co., Cincinnati, O.
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Colburn Mch. Tool Co., Franklin, Pa.
Davis Mch. Tool Co., Inc., Rochester, N. Y.
Defiance Machine Works, Defiance, O.
Detroit Tool Co., Detroit, Mich.
Foote-Burt Co., Cleveland, O.
Fosdick Mch. Tool Co., Cincinnati, O.
Garvin Mch. Co., Spring and Varick Sts., New York.
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Langelier Mfg. Co., Providence, R. I.
Leland-Gifford Co., Worcester, Mass.
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Rockford Lathe & Drill Co., Rockford, Ill.
Sellers & Co., Inc., Wm., Philadelphia, Pa.
Sibley Mch. Co., 8 Tutt St., South Bend, Ind.
Silver Mfg. Co., Salem, O.
Sipp Mch. Co., Paterson, N. J.
Snyder & Son, J. E., Worcester, Mass.
Standard Mfg. Co., Bridgeport, Conn.
Superior Mch. Tool Co., Kokomo, Ind.
Taylor & Fenn Co., Hartford, Conn.
Weigel Mch. Tool Co., Peru, Ind.

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Busch Co., J. C., 1763 Elston Ave., Chicago, Ill.
Canedy-Otto Mfg. Co., Chicago Heights, Ill.

Drill Presses
Mason, Inc., A. C., Paterson, N. J.

Drill Rod
Aborn Steel Co, Inc., 26 Clarke St., New York.

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Cleveland Twist Drill Co., Cleveland, O.
Detroit Twist Drill Co., Detroit, Mich.
Morse Twist Drill & Machine Co., New Bedford, Mass.
National Twist Drill & Tool Co., Detroit, Mich.
Pratt & Whitney Co., Hartford, Conn.
Slocomb Co., J. T., Providence, R. I.
Standard Tool Co., Cleveland, O.

Drills, Ratchet
Armstrong Bros. Tool Co., 313 N. Francisco Ave., Chicago, Ill.
Cleveland Twist Drill Co., Cleveland, O.
Detroit Twist Drill Co., Detroit, Mich.
Goodell-Pratt Co., Greenfield, Mass.
Greene, Tweed & Co., 109 Duane St., New York.
National Twist Drill & Tool Co., Detroit, Mich.
Pratt & Whitney Co., Hartford, Conn.
Standard Tool Co., Cleveland, O.
Walworth Mfg. Co., Boston, Mass.
Whitman & Barnes Mfg. Co., 1000 West 120th St., Chicago, Ill.

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Boker & Co., Inc., H., 101 Duane St., New York.
Clark Equipment Co., Buchanan, Mich.
Cleveland Twist Drill Co., Cleveland, O.
Colton Co., Arthur, Detroit, Mich.
Detroit Twist Drill Co., Detroit, Mich.
Frasse & Co., Inc., Peter A., 417 Canal St., New York.
Hammacher, Schlemmer & Co., 4th Ave. and 13th St., New York.
Morse Twist Drill & Mch. Co., New Bedford, Mass.
National Twist Drill & Tool Co., Detroit, Mich.
Pratt & Whitney Co., Hartford, Conn.
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Union Twist Drill Co., Athol, Mass.
Whitman & Barnes Mfg. Co., 1000 West 120th St., Chicago, Ill.

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Manufacturing Equipment & Eng. Co., Framingham, Mass.

Dynamos
Eck Dynamo & Motor Co., Belleville, N. J.
Electro Dynamic Co., Bayonne, N. J.
General Electric Co., Schenectady, N. Y.
Reliance Electric & Eng. Co., 1056 Ivanhoe Road, Cleveland, O.
Sprague Electric Works, 527 W. 34th St., New York.
Wagner Electric Mfg. Co., St. Louis, Mo.
Westinghouse Elec. & Eng. Co., East Pittsburgh, Pa.

Electrical Supplies
General Electric Co., Schenectady, N. Y.
Wagner Electric Mfg. Co., St. Louis, Mo.
Westinghouse Elec. & Eng. Co., East Pittsburgh, Pa.

Elevators
Albro-Clem Elevator Co., 501 Erie Ave., East, Philadelphia, Pa.
Link-Belt Company, Chicago, Ill.
Northern Engineering Works, Detroit, Mich.

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Emery Wheel Dressers
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Engines, Oil and Gas
Worthington Pump & Mchy. Corp., 115 Broadway, New York.

Engines, Steam
Buckeye Engine Co., Salem, O.
Buffalo Forge Co., Buffalo, N. Y.

Expanders, Tube
Nicholson & Co., W. H., 112 Oregon St., Wilkes-Barre, Pa.
Watson-Stillman Co., 192 Fulton St., New York.

Expansion Joints
Nuttall Co., R. D., Pittsburgh, Pa.

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Willson & Co., Inc., T. A., Reading, Pa.

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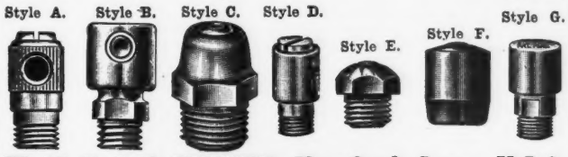
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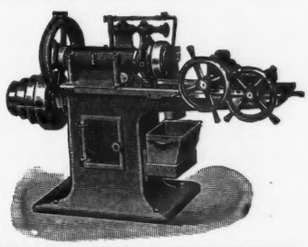
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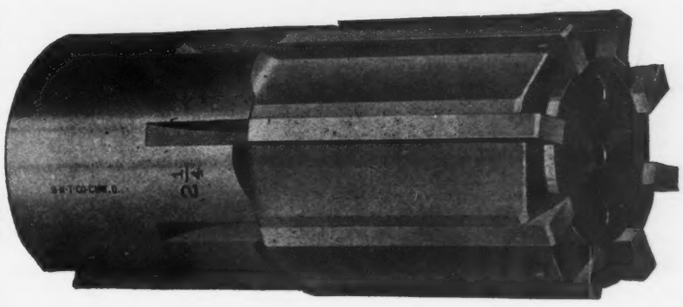
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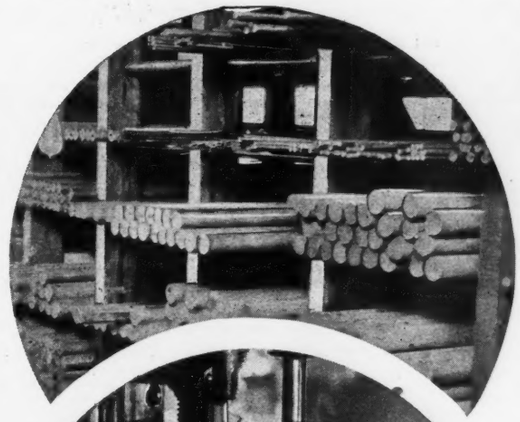
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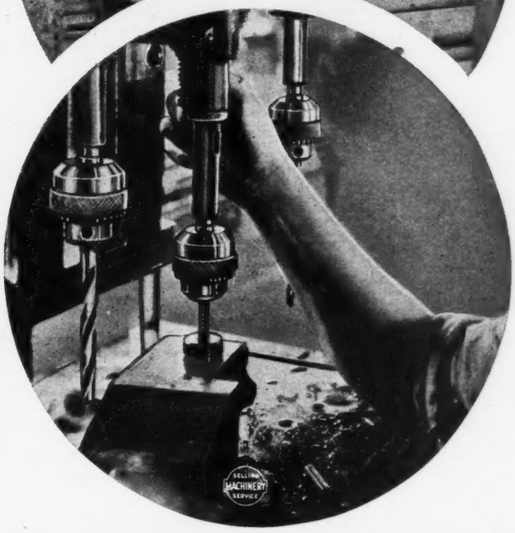
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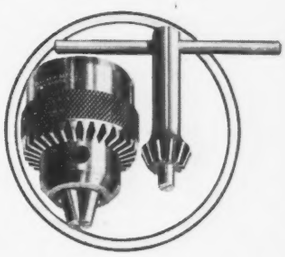
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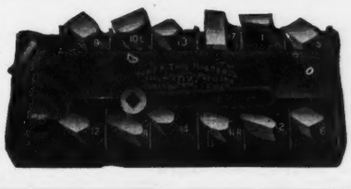
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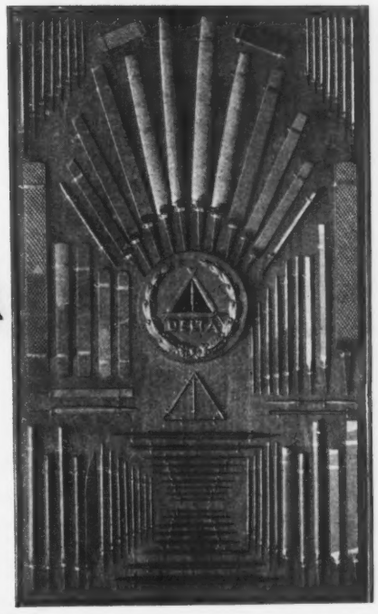


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Stahl Gear & Mch. Co., Cleveland, O.

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Horsburgh & Scott Co., Cleveland, O.
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Nuttall Co., R. D., Pittsburgh, Pa.
Stahl Gear & Mch. Co., Cleveland, O.

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Gisholt Mch. Co., Madison, Wis.
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Blevney Mch. Co., Greenfield, Mass.

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Greenfield Mch. Co., Greenfield, Mass.
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Greenfield Mch. Co., Greenfield, Mass.
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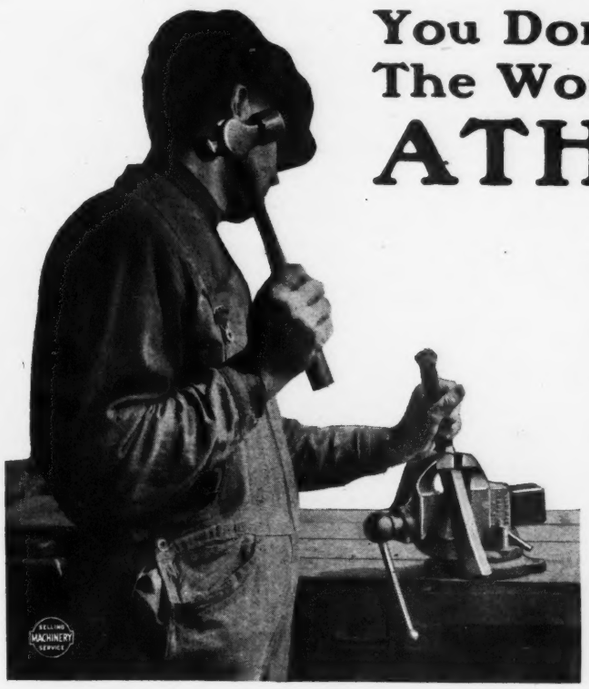
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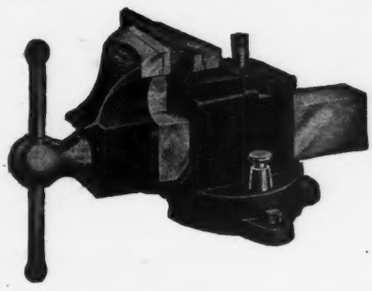
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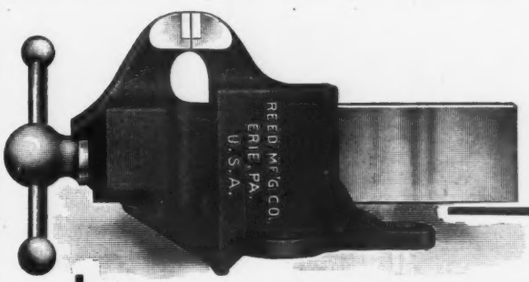
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Dickow, Fred C., 37 Desplaines St., Chicago, Ill.

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Urbana Tool & Die Co., Urbana, O.
Western Tool Co., Newark, N. J.
Wilcox Motor & Mfg. Co., Saginaw, Mich.
Windau Tool Co., Cleveland, O.

Kettles, Soda
Brown & Sharpe Mfg. Co., Providence, R. I.
Niles-Bement-Pond Co., 111 Broadway, New York.

Keyseaters
Baker Bros., Toledo, O.
Defiance Machine Works, Defiance, O.
Lapointe Mch. Tool Co., Hudson, Mass.
Mitts & Merrill, 843 Water St., Saginaw, Mich.
Morton Mfg. Co., Muskegon Heights, Mich.
Newton Mch. Tool Works, Inc., 23rd and Vine Sts., Philadelphia, Pa.
Niles-Bement-Pond Co., 111 Broadway, New York.

Keyseaters, Cutters for
Davis Mch. Co., Inc., C. F., Rochester, N. Y.

Keyseaters, Portable
Burr & Son, J. T., Brooklyn, N. Y.
Bucher-Smith Co., East Liverpool, O.

Keys, Machine
Morton Mfg. Co., Muskegon Heights, Mich.
Standard Gauge Steel Co., Beaver Falls, Pa.
Whitney Mfg. Co., Hartford, Conn.
Williams & Co., J. H., 61 Richards St., Brooklyn, N. Y.

Knives, Machine
Coes Wrench Co., Worcester, Mass.
Simonds Mfg. Co., Fitchburg, Mass.

Knurl Holders
Graham Mfg. Co., Providence, R. I.
Pratt & Whitney Co., Hartford, Conn.

Knurling Tools
Armstrong Bros. Tool Co., 313 N. Francisco Ave., Chicago, Ill.
Goodell-Pratt Co., Greenfield, Mass.
Greenfield Tap & Die Corp., Greenfield, Mass.
Pratt & Whitney Co., Hartford, Conn.
Williams & Co., J. H., 61 Richards St., Brooklyn, N. Y.

Lamp Guards, Etc.
McCrosky Reamer Co., Meadville, Pa.
Newman Mfg. Co., Cincinnati, O.

Lamps, Electric
General Electric Co., Schenectady, N. Y.

Lapping Machines, Power
Builders Iron Foundry, Providence, R. I.
Potter Tool & Machine Works, 79 E. 130th St., New York.

Lathe Attachments
American Tool Works Co., Cincinnati, O.
Barnes Co., W. F. & John, 231 Ruby St., Rockford, Ill.
Barnes Drill Co., Inc., 814 Chestnut St., Rockford, Ill.
Boye & Emmes Mch. Tool Co., Cincinnati, O.
Bradford Mch. Tool Co., Cincinnati, O.
Bridgeford Mch. Tool Works, 151 Winton Road, Rochester, N. Y.
Carroll-Jamieson Mch. Tool Co., 527 Davis St., Batavia, O.
Champion Tool Works Co., 4955 Spring Grove Ave., Cincinnati, O.
Chard Lathe Co., Newcastle, Ind.
Cincinnati Iron & Steel Co., Cincinnati, O.
Davis Mch. Tool Co., Inc., Rochester, N. Y.
Diamond Mch. Co., Providence, R. I.
Fischer Mch. Co., Philadelphia, Pa.
Fitchburg Mch. Works, Fitchburg, Mass.
Flather & Co., Inc., Nashua, N. H.
Garvin Mch. Co., Spring and Varick Sts., New York.
Greaves-Klusman Tool Co., Cincinnati, O.
Hendey Mch. Co., Torrington, Conn.
LeBlond Mch. Tool Co., R. K., Cincinnati, O.
Lodge & Shipley Mch. Tool Co., Cincinnati, O.
Manning, Maxwell & Moore, Inc., 119 W. 40th St., New York.
Monarch Mch. Tool Co., Sidney, O.
Mueller Mch. Tool Co., Cincinnati, O.
Mulliner-Enlund Tool Co., Inc., Syracuse, N. Y.
Newman Mfg. Co., Cincinnati, O.
Niles-Bement-Pond Co., 111 Broadway, New York.
Oliver Machinery Co., Grand Rapids, Mich.
Pratt & Whitney Co., Hartford, Conn.
Reed-Prentice Co., F. E. Reed Dept. and Prentice Bros. Dept., Worcester, Mass.
Rivett Lathe & Grinder Co., Brighton, Boston, Mass.
Rockford Tool Co., Rockford, Ill.
Sebastian Lathe Co., Cincinnati, O.
Springfield Mch. Tool Co., 631 Southern Ave., Springfield, O.
Vandyck Churchill Co., 149 Broadway, New York.
Willard Machine Tool Co., Cincinnati, O.
Wood & Safford Machine Works, Great Falls, Mont.

Lathe Dogs
Armstrong Bros. Tool Co., 313 N. Francisco Ave., Chicago, Ill.
Hammacher, Schlemmer & Co., 4th Ave. and 13th St., New York.
Ready Tool Co., 650 Railroad Ave., Bridgeport, Conn.
Underwood & Co., H. B., Philadelphia, Pa.
Western Tool & Mfg. Co., Springfield, O.
Williams & Co., J. H., 61 Richards St., Brooklyn, N. Y.

Lathe, Planer and Shaper Tools
Armstrong Bros. Tool Co., 313 N. Francisco Ave., Chicago, Ill.
Chard Lathe Co., Newcastle, Ind.
Gisholt Mch. Co., Madison, Wis.
Lovejoy Tool Co., Inc., Springfield, Vt.
McCrosky Reamer Co., Meadville, Pa.
Metzger Welding Co., Cincinnati, O.
O. K. Tool Holder Co., Shelton, Conn.
Pratt & Whitney Co., Hartford, Conn.
Ready Tool Co., 650 Railroad Ave., Bridgeport, Conn.
Sebastian Lathe Co., Cincinnati, O.
Thompson & Son Co., Henry G., New Haven, Conn.
West Haven Mfg. Co., New Haven, Conn.
Western Tool & Mfg. Co., Springfield, O.
Williams & Co., J. H., 61 Richards St., Brooklyn, N. Y.

Lathes, Automatic
Fitchburg Automatic Mch. Works, Fitchburg, Mass.
Gisholt Mch. Co., Madison, Wis.
Jones & Lamson Mch. Co., New Britain, Conn.
National Acme Co., Cleveland, O.
New Britain Mch. Co., New Britain, Conn.
Potter & Johnston Mch. Co., Pawtucket, R. I.
Reed-Prentice Co., F. E. Reed Dept. and Prentice Bros. Dept., Worcester, Mass.

Lathes, Automatic Screw Threading
Automatic Machine Co., Bridgeport, Conn.

Lathes, Axle
Bridgeford Mch. Tool Works, 151 Winton Road, Rochester, N. Y.
Fitchburg Machine Works, Fitchburg, Mass.
Manning, Maxwell & Moore, Inc., 119 W. 40th St., New York.
Niles-Bement-Pond Co., 111 Broadway, New York.
Sellers & Co., Inc., Wm., Philadelphia, Pa.

Lathes, Bench
Ames Co., B. C., Waltham, Mass.
Dalton Manufacturing Corporation, 1911 Park Ave., New York.
Diamond Mch. Co., Providence, R. I.
Elgin Tool Works, Elgin, Ill.
Goodell-Pratt Co., Greenfield, Mass.
Greenfield Tap & Die Corp., Greenfield, Mass.
Hardinge Bros., Inc., Berteau and Ravenswood Aves., Chicago, Ill.
Hjorth Lathe & Tool Co., Boston, Mass.
Potter Tool & Mch. Wks., S. A., 79 E. 130th St., New York.
Pratt & Whitney Co., Hartford, Conn.
Rivett Lathe & Grinder Co., Brighton, Boston, Mass.
Rockford Lathe & Drill Co., Rockford, Ill.
Sloan & Chace Mfg. Co., Ltd., Newark, N. J.
Van Norman Mch. Tool Co., Springfield, Mass.
Waltham Mch. Works, Waltham, Mass.

Lathes, Boring
Gisholt Mch. Co., Madison, Wis.
Sellers & Co., Inc., Wm., Philadelphia, Pa.

Lathes, Brass Workers'
Acme Machine Tool Co., Cincinnati, O.
Bardons & Oliver, Cleveland, O.
Dreses Machine Tool Co., Cincinnati, O.
Garvin Mch. Co., Spring and Varick Sts., New York.
Springfield Mch. Tool Co., 631 Southern Ave., Springfield, O.
Warner & Swasey Co., Cleveland, O.
Wood Turret Mch. Co., Brazil, Ind.

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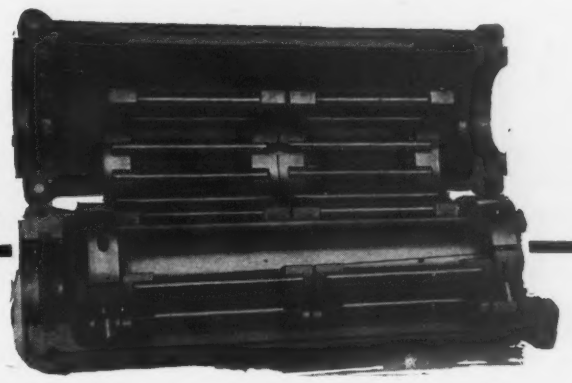
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Lathes, Car Wheel
Manning, Maxwell & Moore, Inc., 119 W. 40th St., New York.
Niles-Bement-Pond Co., 111 Broadway, New York.
Sellers & Co., Inc., Wm., Philadelphia, Pa.

Lathes, Crankshaft
American Tool Works Co., Cincinnati, O.
LeBlond Mch. Tool Co., R. K., Cincinnati, O.
Lodge & Shipley Mch. Tool Co., Cincinnati, O.
Niles-Bement-Pond Co., 111 Broadway, New York.

Lathes, Engine
Adams, Ogden R., Rochester, N. Y., 12".
Amalgamated Mchy. Corp., 72 W. Adams St., Chicago, Ill. 27½".
American Tool Works Co., Cincinnati, O. 14" and 24", inclusive.
Axelson Mch. Co., Los Angeles, Cal. 16" and 18".
Barnes Co., W. F. & John, Rockford, Ill. 9" to 18", inclusive.
Barnes Drill Co., Rockford, Ill. 14-24" and 22-36" gap.
Boye and Emmes Mch. Tool Co., Cincinnati, O. 18" to 48", inclusive.
Bradford Mch. Tool Co., Cincinnati, O. 14" to 42", inclusive.
Bridgeford Mch. Tool Works, 151 Winton Road, Rochester, N. Y. 26" to 60", inclusive.
Carroll-Jamieson Mch. Tool Co., 257 Davis St., Batavia, O. 13" and 14".
Champion Tool Works Co., 4955 Spring Grove Ave., Cincinnati, O. 12" to 18", inclusive.
Chard Lathe Co., Newcastle, Ind. 16" to 28", inclusive.
Cincinnati Iron & Steel Co., Cincinnati, O. 14" to 24", inclusive.
Cincinnati Lathe & Tool Co., Oakley, Cincinnati, O. 16" to 22", inclusive.
Cleveland Mchy. & Supply Co., Cleveland, O. 12", 16", 20", 26½".
Crawford Machine Tool Co., Inc., Erie, Pa. 15" to 25".
Dalton Manufacturing Corporation, 1911 Park Ave., New York. 6" to 18", inclusive
Davis Mch. Co., Inc., C. F., Rochester, N. Y. 11".
Davis Mch. Tool Co., Inc., Rochester, N. Y. 12" to 42", inclusive.
Earle Gear & Mch. Co., Philadelphia, Pa. 14" and 18".
Flather & Co., Inc., Nashua, N. H. 13" to 28", inclusive.
Fulton Mch. Tool Co., 1438 Bryan Place, Chicago, Ill. 18".
Giddings & Lewis Mfg. Co., Fond du Lac, Wis. 15", 16" and 18"
Gisholt Mch. Co., Madison, Wis. 16" and 25".
Greaves-Klusman Tool Co., Cincinnati, O. 16" to 30".
Hamilton Mch. Tool Co., Hamilton, O. 14" to 24".
Hendey Mch. Co., Torrington, Conn. 12" to 24".
Hill, Clarke & Co., Inc., Boston, Mass. 18" to 30", inclusive.
Houston, Stanwood & Gamble Co., Cincinnati, O. 30" to 60", inclusive.
LeBlond Mch. Tool Co., R. K., Cincinnati, O. 12" to 36".
Lehmann Mch. Co., St. Louis, Mo. 16" and 18".
Lodge & Shipley Mch. Tool Co., Cincinnati, O. 14" to 48", inclusive.
Manning, Maxwell & Moore, Inc., 119 W. 40th St., New York. 12" to 84", inclusive.
Monarch Mch. Tool Co., Sidney, O. 10" to 30", incl.
Morris Mch. Tool Co., Cincinnati, O. 16" to 21", incl.
Mueller Mch. Tool Co., Cincinnati, O. 18".
Mulliner-Enlund Tool Co., Inc., Syracuse, N. Y. 12" and 14".
National Lathe Co., Cincinnati, O. 16", 17", 18", 22" and 24".
Niles-Bement-Pond Co., 111 Broadway, New York. 26" to 120", inclusive.
Oliver Machinery Co., Grand Rapids, Mich. 16" to 26", inclusive.
Porter-Cable Mch. Co., Syracuse, N. Y. 12".
Pratt & Whitney Co., Hartford, Conn. 10" to 16", inclusive.
Reed-Prentice Co., F. E. Reed Dept. and Prentice Bros. Dept., Worcester, Mass. 12" to 27", inclusive.
Rockford Lathe & Drill Co., Rockford, Ill. 13", 14", 16", 17", 18".
Rockford Tool Co., Rockford, Ill. 15" and 16".
Sebastian Lathe Co., Cincinnati, O. 13", 14", 15".
Shepard Lathe Co., Cincinnati, O. 12".
Sidney Tool Co., Sidney, O. 17" and 19".
Smith Mfg. Co., Philip, Sidney, O. 13" and 14".
South Bend Lathe Works, South Bend, Ind. 13" to 24", inclusive.
Springfield Mch. Tool Co., Springfield, O. 14" to 36", inclusive.
Summit Mch. Works, Worcester, Mass. 10".
Superior Mch. Tool Co., Kokomo, Ind. 18" and 20".
Victor Lathe Co., 151 Lafayette St., New York. 9".
Walcott Lathe Co., Jackson, Mich. 14" to 29", incl.
Whitcomb-Blaisdell Mch. Tool Co., Worcester, Mass. 14" to 30", inclusive.
Willard Mch. Tool Co., Cincinnati, O. 13".
Worcester Lathe Co. Worcester, Mass. 11", 13" and 16".

Lathes, Extension Bed and Gap
Barnes Drill Co., Inc., 814 Chestnut St., Rockford, Ill.
Harrington, Son & Co. Inc., Edwin, Philadelphia, Pa.
Manning, Maxwell & Moore, Inc., 119 West 40th St., New York.
Sebastian Lathe Co., Cincinnati, O.

Lathes, Foot Power
Barnes Co., W. F. and John, 231 Ruby St., Rockford, Ill.
Reed-Prentice Co., F. E. Reed Dept. and Prentice Bros. Dept., Worcester, Mass.

Lathes, Gun Boring
Amalgamated Machinery Corp., 72 W. Adams St., Chicago, Ill.
LeBlond Mch. Tool Co., R. K., Cincinnati, O.

Lathes, Patternmakers'
Blount Co., J. G., Everett, Mass.
Defiance Machine Works, Defiance, O.
Greenfield Tap & Die Corp., Greenfield, Mass.
Oliver Machinery Co., Grand Rapids, Mich.
Summit Mch. Works, Worcester, Mass.

Lathes, Pulley
Cincinnati Pulley Mchy. Co., Cincinnati, O.

Lathes, Shaft
Bridgeford Mch. Tool Works, 151 Winton Road, Rochester, N. Y.
Fitchburg Machine Works, Fitchburg, Mass.
Manning, Maxwell & Moore, Inc., 119 W. 40th St., New York.
Niles-Bement-Pond Co., 111 Broadway, New York.
Sellers & Co., Inc., Wm., Philadelphia, Pa.

Lathes, Speed
Blount Co., J. G., Everett, Mass.
Diamond Mch. Co., Providence, R. I.
Greenfield Tap & Die Corp., Greenfield, Mass.
Oliver Machinery Co., Grand Rapids, Mich.
Potter Tool & Mch. Wks., S. A., 79 E. 130th St., New York.
Summit Machine Works, Worcester, Mass.

Lathes, Turret
See also Chucking Machines.
Acme Mch. Tool Co., Cincinnati, O.
Bardons & Oliver, Cleveland, O.
Brown & Sharpe Mfg. Co., Providence, R. I.
Bullard Mch. Tool Co., Bridgeport, Conn.
Davis Mch. Tool Co., Inc., Rochester, N. Y.
Dreses Mch. Tool Co., Cincinnati, O.
Foster Mch. Co., Elkhart, Ind.
Fulton Mch. Tool Co., 1438 Bryan Pl., Chicago, Ill.
Garvin Mch. Co., Spring and Varick Sts., New York.
Gisholt Mch. Co., Madison, Wis.
Greaves-Klusman Tool Co., Cincinnati, O.
International Mch. Tool Co., Indianapolis, Ind.
Jones & Lamson Mch. Co., Springfield, Vt.
LeBlond Mch. Tool Co., R. K., Cincinnati, O.
Lodge & Shipley Mch. Tool Co., Cincinnati, O.
Morris Mch. Tool Co., Cincinnati, O.
New Britain Mch. Co., New Britain, Conn.
Niles-Bement-Pond Co., 111 Broadway, New York.
Oliver Machinery Co., Grand Rapids, Mich.
Pratt & Whitney Co., Hartford, Conn.
Reed-Prentice Co., F. E. Reed Dept. and Prentice Bros. Dept., Worcester, Mass.
Rivett Lathe & Grinder Co., Brighton, Boston, Mass.
Southworth Mch. Co., Portland, Maine
Springfield Mch. Tool Co., 631 Southern Ave., Springfield, O.
Steinle Turret Mch. Co., Madison, Wis.
Warner & Swasey Co., Cleveland, O.
Wood Turret Mch. Co., Brazil, Ind.

Lathes, Woodworkers'
Barnes Co., W. F. and John, 231 Ruby St., Rockford, Ill.
Defiance Machine Works, Defiance, O.
Oliver Machinery Co., Grand Rapids, Mich.
Reed-Prentice Co., F. E. Reed Dept. and Prentice Bros. Dept., Worcester, Mass.

Laying-out Fixture for Tool Work
Craley Mfg. Co., Mount Joy, Pa.

Leather Belting, Round
Schieren Co., Chas. A., 73 Ferry St., New York.

Levels
Goodell-Pratt Co., Greenfield, Mass.
Keuffel & Esser Co., Hoboken, N. J.
Starrett Co., L. S., Athol, Mass.

Light Brackets, Electric, Adjustable
Newman Mfg. Co., Cincinnati, O.

Lockers, Metal
Manufacturing Equipment & Eng. Co., Framingham, Mass.

Lubricants
American Petroleum Products Co., Cleveland, O.
Besly & Co., Chas. A., 120-B N. Clinton St., Chicago, Ill.
Cataract Refining & Mfg. Co., Buffalo, N. Y.
Dixon Crucible Co., Joseph, Jersey City, N. J.
Fiske Bros. Refining Co., 24 State St., New York.
Haws, Inc., Geo. A., 135 Front St., New York.
Lumen Bearing Co., Buffalo, N. Y.
Oakley Chemical Co., 26 Thames St., New York.
Royersford Foundry & Mch. Co., 54 N. 5th St., Philadelphia, Pa.
S K F Ball Bearing Co., Hartford, Conn.
Texas Company, 17 Battery Place, New York.

Lubricators
Besly & Co., Chas. A., 120-B N. Clinton St., Chicago, Ill.
Greene, Tweed & Co., 109 Duane St., New York.
Michigan Lubricator Co., Detroit, Mich.

Machinery Dealers
Besly & Co., Chas. A., 120-B N. Clinton St., Chicago, Ill.
Brownell Mchy. Co., Providence, R. I.
Davis Mch. Tool Co., Inc., Wm. F., 549 W. Washington Blvd., Chicago, Ill.
Dickow, Fred Co., 37 So. Desplaines St., Chicago, Ill.
Earle Gear & Mch. Co., 4705 Stenton Ave., Philadelphia, Pa.
Easley Mchy. Co., E. L., 555 Washington Blvd., Chicago, Ill.
Garvin Mch. Co., Spring and Varick Sts., New York.
Hill, Clarke & Co., Inc., Boston, Mass.
Hill, Clarke & Co. of Chicago, 625 Washington Blvd., Chicago, Ill.
Kinsey Co., E. A., Cincinnati, O.
Lucas & Son, Inc., J. L., Bridgeport, Conn.
Lynd-Farquhar Co., Boston, Mass.
Manning, Maxwell & Moore, Inc., 119 W. 40th St., New York.
Marshall & Huschart Mchy. Co., 17 So. Jefferson St., Chicago, Ill.
McDonough Mfg. Co., Eau Claire, Wis.
Motch & Merryweather Mchy. Co., Cleveland, O.
Niles-Bement-Pond Co., 111 Broadway, New York.
Osgood Tool Co., J. L., Buffalo, N. Y.
Pattison Supply Co., W. M., Cleveland, O.
Simmons Mch. Co., Inc., Albany, N. Y.
Vandyke Churchill Co., 149 Broadway, New York.
Young, Corley & Dolan, Inc., 115 Broadway, New York.

Machinists' Small Tools
See Calipers, Hammers, Wrenches, Drills, Taps, etc.

Mallets, Rawhide
Chicago Rawhide Mfg. Co., 1301 Elston Ave., Chicago, Ill.

Mandrels, Expanding and Solid
See Arbors and Mandrels, Expanding and Solid.

Marking Machines
Grant Mfg. & Mch. Co., N. W. Station, Bridgeport, Conn.
Greenfield Tap & Die Corp., Greenfield, Mass.
Noble & Westbrook Mfg. Co., Hartford, Conn.

Marking Machines, Electric
Swedish Gage Co., Inc., 245 W. 55th St., New York.

Measuring Machines, Precision
American Gauge Co., Dayton, O.
Pratt & Whitney Co., Hartford, Conn.
Rogers Works, Inc., J. M., Gloucester City, N. J.

Metallographic Apparatus
Holz, Herman A., Metropolitan Bldg., New York.

Metals, Bearing
See Bearings, Bronze, Babbitt, etc., and Bushings, Brass, Bronze, etc.

Microscopes (Metallurgical)
Holz, Herman A., Metropolitan Bldg., New York.

Milling and Drilling Machines, Upright
Knight Mchy. Co., W. B., St. Louis, Mo.

Milling Attachments
Adams Co., Dubuque, Iowa.
Becker Milling Machine Co., Hyde Park, Mass.
Brown & Sharpe Mfg. Co., Providence, R. I.
Carroll, William, Cincinnati, O.
Cincinnati Milling Mch. Co., Oakley, Cincinnati, O.
Garvin Mch. Co., Spring and Varick Sts., New York.
Hendey Machine Co., Torrington, Conn.
Ingersoll Milling Machine Co., Rockford, Ill.
Kearney & Trecker Co., Milwaukee, Wis.
Kempsmith Mfg. Co., Milwaukee, Wis.
LeBlond Mch. Tool Co., R. K., Cincinnati, O.
Oesterlein Mch. Co., Cincinnati, O.
Porter-Cable Mch. Co., Syracuse, N. Y.
Pratt & Whitney Co., Hartford, Conn.
Rivett Lathe & Grinder Co., Brighton, Boston, Mass.
Rockford Milling Machine Co., Rockford, Ill.
Standard Engineering Works, Pawtucket, R. I.
Whitney Mfg. Co., Hartford, Conn.

Milling Machines, Automatic
Pratt & Whitney Co., Hartford, Conn.

Milling Machines, Bench
Ames Co., B. C., Waltham, Mass.
Burke Machine Tool Co., Conneaut, O.
Carter Hakes Co., Sterling Place, Winsted, Conn.
Greenfield Tap & Die Corp., Greenfield, Mass.
Hardinge Bros., Inc., Berteau and Ravenswood Aves., Chicago, Ill.
Rockford Milling Machine Co., Rockford, Ill.
Sloan & Chace Mfg. Co., Ltd., Newark, N. J.
Van Norman Mch. Tool Co., Waltham Ave., Springfield, Mass.

Milling Machines, Circular Continuous
Becker Milling Machine Co., Hyde Park, Mass.
Gould & Eberhardt, Newark, N. J.

Milling Machines, Hand
Adams Co., Dubuque, Iowa.
Becker Milling Machine Co., Hyde Park, Mass.
Bickett Mch. & Mfg. Co., Cincinnati, O.
Biggs-Watterson Co., Cleveland, O.
Burke Machine Tool Co., Conneaut, O.
Carter & Hakes Co., Sterling Place, Winsted, Conn.
Cleveland Milling Machine Co., Cleveland, O.
Davenport Mfg. Co., Meadville, Pa.
Defiance Machine Works, Defiance, O.
Garvin Mch. Co., Spring and Varick Sts., New York.
Greenfield Tap & Die Corp., Greenfield, Mass.
Pratt & Whitney Co., Hartford, Conn.
Rockford Milling Mch. Co., Rockford, Ill.
Standard Engineering Works, Pawtucket, R. I.
Steptoe Co., John, Brighton, Cincinnati, O.
Van Norman Mch. Tool Co., Waltham Ave., Springfield, Mass.
Whitney Mfg. Co., Hartford, Conn.

Milling Machines, Horizontal, Plain
Adams Co., Dubuque, Iowa.
Beaman & Smith Co., Providence, R. I.
Becker Milling Machine Co., Hyde Park, Mass.
Bilton Mch. Tool Co., Bridgeport, Conn.
Brown & Sharpe Mfg. Co., Providence, R. I.
Cincinnati Milling Mch. Co., Oakley, Cincinnati, O.
Cleveland Milling Machine Co., Cleveland, O.
Davenport Mfg. Co., Meadville, Pa.
Defiance Machine Works, Defiance, O.
Garvin Mch. Co., Spring and Varick Sts., New York.
Gooley & Eglund, Inc., Cortland, New York.
Hendey Machine Co., Torrington, Conn.
Ingersoll Milling Machine Co., Rockford, Ill.
Kearney & Trecker Co., Milwaukee, Wis.
Kempsmith Mfg. Co., Milwaukee, Wis.
LeBlond Mch. Tool Co., R. K., Cincinnati, O.
Newton Mch. Tool Works, Inc., 23rd and Vine Sts., Philadelphia, Pa.
Niles-Bement-Pond Co., 111 Broadway, New York.
Oesterlein Mch. Co., Cincinnati, O.
Pratt & Whitney Co., Hartford, Conn.
Rockford Milling Mch. Co., Rockford, Ill.
Standard Engineering Works, Pawtucket, R. I.
Steptoe Co., John, Cincinnati, O.

Milling Machines, Horizontal, Universal
Becker Milling Machine Co., Hyde Park, Mass.
Brown & Sharpe Mfg. Co., Providence, R. I.
Cincinnati Milling Mch. Co., Oakley, Cincinnati, O.
Cleveland Milling Machine Co., Cleveland, O.
Defiance Machine Works, Defiance, O.
Hendey Machine Co., Torrington, Conn.
Kearney & Trecker Co., Milwaukee, Wis.
Kempsmith Mfg. Co., Milwaukee, Wis.
LeBlond Mch. Tool Co., R. K., Cincinnati, O.
Newton Mch. Tool Works, Inc., 23rd and Vine Sts., Philadelphia, Pa.
Niles-Bement-Pond Co., 111 Broadway, New York.
Oesterlein Mch. Co., Cincinnati, O.
Rockford Milling Mch. Co., Rockford, Ill.
Rowbottom Mch. Co., Waterbury, Conn.
Van Norman Mch. Tool Co., Waltham Ave., Springfield, Mass.

Milling Machines, Lincoln Type
Beaman & Smith Co., Providence, R. I.
Becker Milling Machine Co., Hyde Park, Mass.
Garvin Mch. Co., Spring and Varick Sts., New York.
Hendey Machine Co., Torrington, Conn.
Kempsmith Mfg. Co., Milwaukee, Wis.
Reynolds Mch. Co., Massillon, O.
Van Norman Mch. Tool Co., Waltham Ave., Springfield, Mass.

Milling Machines, Portable
Newton Mch. Tool Works, Inc., 23rd and Vine Sts., Philadelphia, Pa.
Pedrick Tool & Mch. Co., 3639 N. Lawrence St., Philadelphia, Pa.

Milling Machines, Spline
Standard Engineering Works, Pawtucket, R. I.

KNIGHT

Milling and Drilling Machines

This One Has Paid for Itself Many Times

The accompanying photograph was taken in the plant of the John Y. Parke Company, Philadelphia. This concern has used the Knight Milling and Drilling Machine for the last three years, and, in the words of the superintendent, "It has paid for itself many times."

The illustration shows the operator milling out an intricate punch—the die in the foreground has just been completed. On this class of work the "Knight" has proved its ability to perform quickly, accurately and economically.

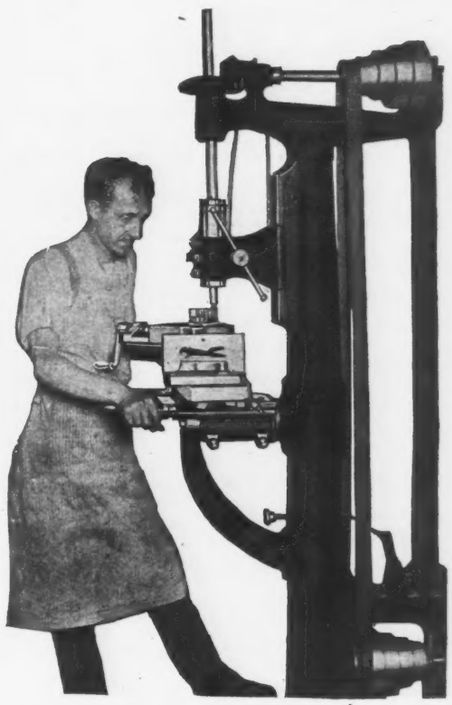
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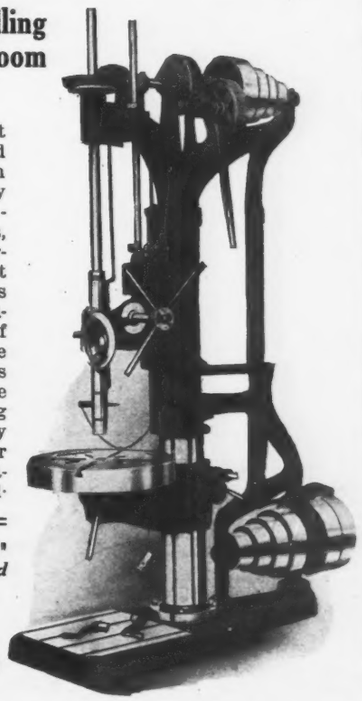
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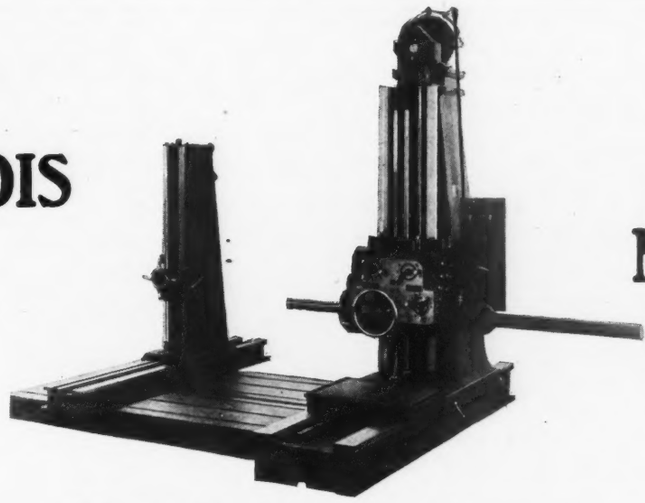
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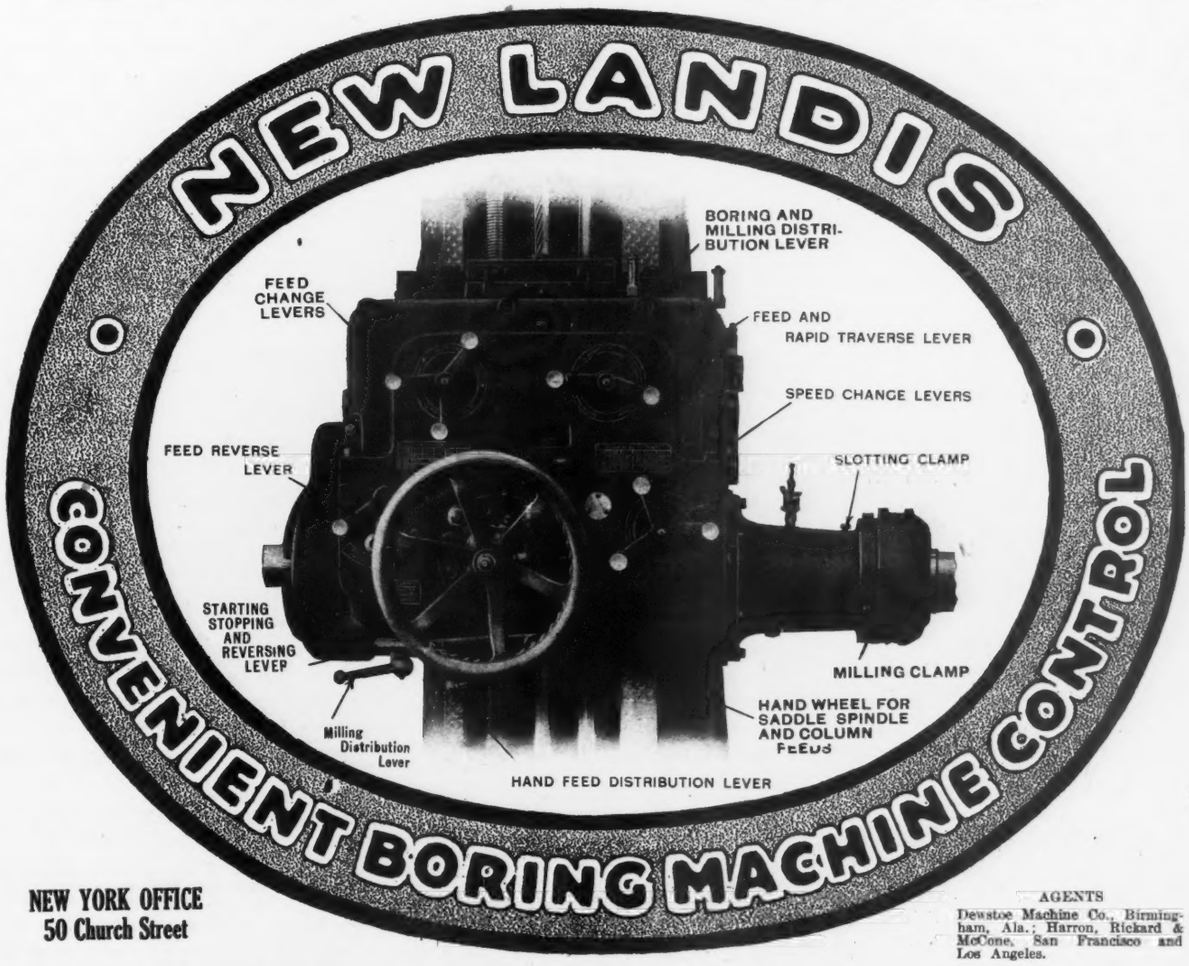
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American Gas Furnace Co., 24 John St., New York.

Ratchets
Billings & Spencer Co., Hartford, Conn.

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Victor Tool Co., Waynesboro, Pa.

Reamers
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Brown & Sharpe Mfg. Co., Providence, R. I.
Brubaker & Bros., W. L., 50 Church St., New York.
Butterfield & Co., Derby Line, Vt.
Card Mfg. Co., S. W., Mansfield, Mass.
Carpenter Tap & Die Co., J. M., Pawtucket, R. I.
Clark Equipment Co., Buchanan, Mich.
Cleveland Twist Drill Co., Cleveland, O.
Columbus Die, Tool & Mch. Co., Columbus, O.
Detroit Twist Drill Co., Detroit, Mich.
Glenzer Co., J. C., Detroit, Mich.
Greenfield Tap & Die Corp., Greenfield, Mass.
Hammacher, Schlemmer & Co., 4th Ave. and 13th St., New York.
Kelly Reamer Co., Cleveland, O.
McCrosky Reamer Co., Meadville, Pa.
Morse Twist Drill & Machine Co., New Bedford, Mass.
National Twist Drill & Tool Co., Detroit, Mich.
Pratt & Whitney Co., Hartford, Conn.
Production Tool Co. of America, Detroit, Mich.
Reiff & Nestor Co., Lykens, Pa.
Rogers Works, Inc., J. M., Gloucester City, N. J.
Schellenbach-Hunt Tool Co., Cincinnati, O.
Standard Tool Co., Cleveland, O.
Taft-Peirce Mfg. Co., Woonsocket, R. I.
Whitman & Barnes Mfg. Co., 1000 West 120th St., Chicago, Ill.
Wilcox Motor & Mfg. Co., Saginaw, Mich.

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Schellenbach-Hunt Tool Co., Cincinnati, O.

Reamers, Aligning
Taft-Peirce Mfg. Co., Woonsocket, R. I.

Reamers, Portable Electric
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Standard Electric Tool Co., Cincinnati, O.
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Brown Instrument Co., Philadelphia, Pa.
General Electric Co., Schenectady, N. Y.

Recording Instruments for Pressure
Bristol Co., Waterbury, Conn.
Brown Instrument Co., Philadelphia, Pa.
Taylor Instrument Companies, Rochester, N. Y.

Recording Instruments for Speed
Bristol Co., Waterbury, Conn.
Brown Instrument Co., Philadelphia, Pa.

Recording Instruments for Temperature
Bristol Co., Waterbury, Conn.
Brown Instrument Co., Philadelphia, Pa.
Hoskins Mfg. Co., 459 Lawton Ave., Detroit, Mich.
Taylor Instrument Companies, Rochester, N. Y.

Recording Instruments for Time
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Brown Instrument Co., Philadelphia, Pa.
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Gorham Tool Co., Detroit, Mich.
Glenzer Co., J. C., Detroit, Mich.

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Taylor Instrument Companies, Rochester, N. Y.

Regulators, Temperature
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Taylor Instrument Companies, Rochester, N. Y.

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Pratt & Whitney Co., Hartford, Conn.
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Sloan & Chace Mfg. Co., Ltd., Newark, N. J.

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Dyson & Sons, Joseph, Cleveland, O.
Johnston & Jennings Co., Addison Road and Lake Shore R. R. Tracks, Cleveland, O.
Machinery Forging Co., Cleveland, O.

Riveters, Hydraulic
Chambersburg Engineering Co., Chambersburg, Pa.
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Niles-Bement-Pond Co., 111 Broadway, New York.
Southwark Foundry & Mch. Co., Philadelphia, Pa.

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Chicago Pneumatic Tool Co., 1060 Fisher Bldg., Chicago, Ill.
Hanna Eng. Works, 1763 Elston Ave., Chicago, Ill.
Independent Pneumatic Tool Co., Chicago, Ill.
Ingersoll-Rand Co., 11 Broadway, New York.
Shepard Electric Crane & Hoist Co., Montour Falls, N. Y.

Riveters, Steam
Hanna Eng. Works, 1763 Elston Ave., Chicago, Ill.

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Southwark Foundry & Mch. Co., Philadelphia, Pa.
Townsend Mfg. Co., H. P., Hartford, Conn.

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Tucker, W. M. & C. F., Hartford, Conn.

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Rope Drives
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Starrett Co., L. S., Athol, Mass.

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Oakley Chemical Co., 26 Thames St., New York.

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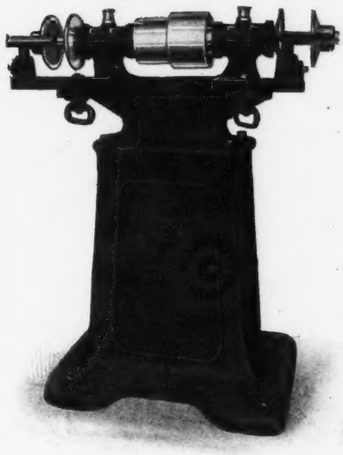
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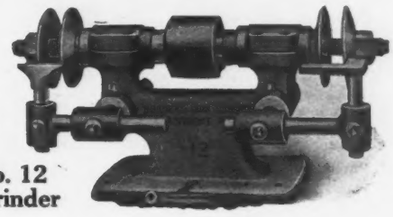
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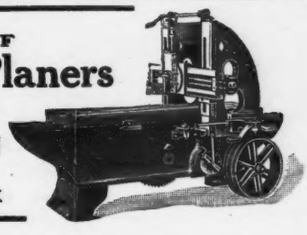


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Bliss Co., E. W., Brooklyn, N. Y.
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Standard Tool Co., Cleveland, O.
Union Twist Drill Co., Athol, Mass.
Whitman & Barnes Mfg. Co., 1000 W. 120th St., Cleveland, O.

Slide Rests
Newton Mch. Tool Works, Inc., 23rd and Vine Sts., Philadelphia, Pa.
Niles-Bement-Pond Co., 111 Broadway, New York.
Reed-Prentice Co., F. E. Reed Dept. and Prentice Bros. Dept., Worcester, Mass.

Slotters, Machine
Baker Bros., Toledo, O.
Dill Mch. Co., T. C., Philadelphia, Pa.
Newton Mch. Tool Works, Inc., 23rd and Vine Sts., Philadelphia, Pa.
Niles-Bement-Pond Co., 111 Broadway, New York.
Sellers & Co., Inc., Wm., Philadelphia, Pa.
Swind Mchy. Co., Philadelphia, Pa.

Slotters, Portable
Newton Mch. Tool Works, Inc., 23rd and Vine Sts., Philadelphia, Pa.

A CATARACT BENCH LATHE
With Turret Attachment



There's no better machine for manufacturing many and various close limit parts than the one here pictured — a Cataract Bench Lathe, with Turret Attachment.

An Excellent Manufacturing Tool

The Davie Tool Company of Cleveland, Ohio, has discovered its merits and has already installed three Cataract Lathes for handling the work on the innumerable small parts used in the Davie Measuring Machine—an extremely sensitive instrument with delicate adjustments secured only by the highest type of precision work.

The three speed countershaft furnished with the "Cataract" is a great asset when changing from small to large diameters. Quick change swing, quick change gear box and other construction features adapt this machine to a wide range of work. Turret, taper, grinding and milling attachments—all readily adjusted—facilitate handling a variety of operations.

There's profit and satisfaction in Cataract Precision Lathes—tool makers know it, and you'll find repeat orders the rule wherever there's a great amount of precision work.

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Hammacher, Schlemmer & Co., 4th Ave. and 13th St., New York.
Morse Twist Drill & Mch. Co., New Bedford, Mass.
National Twist Drill & Tool Co., Detroit, Mich.
Pratt & Whitney Co., Hartford, Conn.
Standard Tool Co., Cleveland, O.
Union Twist Drill Co., Athol, Mass.
Whitman & Barnes Mfg. Co., 1000 W. 120th St., Cleveland, O.

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American Mch. & Foundry Co., 5520 2nd Ave., Brooklyn, N. Y.
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Bilgram Mch. Works, 1231 Spring Garden St., Philadelphia, Pa.
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Hetherington Co., Piqua, O.
Hoggson & Pettis Mfg. Co., New Haven, Conn.
Horton & Son Co., E., Windsor Locks, Conn.
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Langelier Mfg. Co., Providence, R. I.
Lucas Machine Tool Co., Cleveland, O.
Manhattan Mch. & Tool Works, Grand Rapids, Mich.
Mehl Mch. Tool & Die Co., Roselle, N. J.
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Mueller Mch. Tool Co., Cincinnati, O.
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National Automatic Tool Co., Richmond, Ind.
National Machinery Co., Tiffin, O.
National Tool Co., Cleveland, O.
National Twist Drill & Tool Co., Detroit, Mich.
Nelson-Blanck Mfg. Co., Detroit, Mich.
Nelson Tool Co., Inc., 781-783 E. 142nd St., New York.
New Britain Mch. Co., New Britain, Conn.
Newman Mfg. Co., Cincinnati, O.
Newton Mch. Tool Works, Inc., 23rd and Vine Sts., Philadelphia, Pa.
Oster Mfg. Co., Cleveland, O.
Potter Tool & Mch. Wks., S. A., 79 E. 130th St., New York.
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Standard Engineering Co., Ellwood City, Pa.
Steiner Bros., Lima, O.
Swedish Gage Co., Inc., 245 W. 55th St., New York.
Taft-Peirce Mfg. Co., Woonsocket, R. I.
Taylor & Fenn Co., Hartford, Conn.
Taylor-Shantz Co., Rochester, N. Y.
Toledo Mch. & Tool Co., Toledo, O.
Treadwell Engineering Co., Easton, Pa.
Western Tool Co., Newark, N. J.
Wilcox Motor & Mfg. Co., Saginaw, Mich.
Windau Tool Co., Cleveland, O.

Speed Changing Devices
Jones Foundry & Mch. Co., W. A., 4409 W. 12th St., Chicago, Ill.
Moore & White Co., 2707-2737 N. 15th St., Philadelphia, Pa.

Spot Facers
Genesee Mfg. Co., Rochester, N. Y.
Glenzer Co., J. C., Detroit, Mich.

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Baird Machine Co., Bridgeport, Conn.
Hirth Lathe & Tool Co., Boston, Mass.

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Barnes Co., Wallace, South and Parallel Sts., Bristol, Conn.
Blum & Co., Julius, 510 W. 24th St., New York.

Sprocket Chains
Baldwin Chain & Mfg. Co., Worcester, Mass.
Boston Gear Works, Norfolk Downs, Mass.
Caldwell & Son Co., H. W., 17th St. and Western Ave., Chicago, Ill.
Cullman Wheel Co., 1339 Altgeld St., Chicago, Ill.
Diamond Chain & Mfg. Co., Indianapolis, Ind.
Link-Belt Company, Chicago, Ill.
Morse Chain Co., Ithaca, N. Y.
Philadelphia Gear Works, Philadelphia, Pa.
Union Chain & Mfg. Co., Seville, O.
Whitney Mfg. Co., Hartford, Conn.

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Baldwin Chain & Mfg. Co., Worcester, Mass.
Boston Gear Works, Norfolk Downs, Mass.
Cullman Wheel Co., 1339 Altgeld St., Chicago, Ill.
Jones Foundry & Mch. Co., W. A., 4409 W. 12th St., Chicago, Ill.
Meisel Press Mfg. Co., 948 Dorchester Ave., Boston, Mass.
Morse Chain Co., Ithaca, N. Y.
Philadelphia Gear Works, Philadelphia, Pa.
Union Chain & Mfg. Co., Seville, O.

Sprue Cutters
Busch Co., J. C., 1763 Elston Ave., Chicago, Ill.

Squaring Machines
Greenfield Tap & Die Corp., Greenfield, Mass.

Stampings, Sheet Metal
Acklin Stamping Co., 1657 Dorr St., Toledo, O.
American Tool & Mfg. Co., Urbana, O.
Anderson Mfg. Co., Elyria, O.
Blum & Co., Julius, 510 W. 24th St., New York.
Chicago Recording Sale Co., Waukegan, Ill.
Dayton Stamping & Tool Co., Dayton, O.
Kales Stamping Company, Detroit, Mich.
Lansing Stamping & Tool Co., Lansing, Mich.
Premier Snap Fastener Co., 182 Grand St., New York.
Rockford Metal Specialty Co., Rockford, Ill.
Steger & Sons Industrial Works, Steger, Ill.

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Hoggson & Pettis Mfg. Co., New Haven, Conn.
Matthews & Co., Jas. H., 3946 Forbes Field, Pittsburgh, Pa.
Newman Mfg. Co., Cincinnati, O.
Noble & Westbrook Mfg. Co., Hartford, Conn.
Pannier Bros. Stamp Co., Inc., Pittsburgh, Pa.
Schwerdtle Stamp Co., Bridgeport, Conn.

Steam Specialties
Reliance Gauge Column Co., 6008 Carnegie Ave., Cleveland, O.

Steel
Aborn Steel Co., Inc., 26 Clarke St., New York.
Apex Steel Corporation, 50 Church St., New York.
Blum & Co., Julius, 510 W. 24th St., New York.
Boker & Co., Inc., H., 101 Duane St., New York.
Colonial Steel Co., Pittsburgh, Pa.
Firth-Sterling Steel Co., McKeesport, Pa.
Frasse & Co., Inc., Peter A., 417 Canal St., New York.
Halcomb Steel Co., Syracuse, N. Y.
Hawkridge Bros. Co., Boston, Mass.
Heller Bros. Co., Newark, N. J.
Johnston & Jennings Co., Addison Road and Lake Shore R. R. Tracks, Cleveland, O.
Latrobe Electric Steel Co., Latrobe, Pa.
Standard Alloys Co., Pittsburgh, Pa.
Vanadium-Alloys Steel Co., Pittsburgh, Pa.
Vulcan Crucible Steel Co., Aliquippa, Pa.

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Aborn Steel Co., Inc., 26 Clarke St., New York.

Steel, High Speed, Reclaimed
Onondaga Steel Co., Inc., Syracuse, N. Y.

Steel, Heat Treatment of
Steel Improvement & Forge Co., Cleveland, O.

Steel, High Speed, Tool
Aborn Steel Co., Inc., 26 Clarke St., New York.
Allen & Co., Ltd., Edgar, 718 W. Lake St., Chicago, Ill.
Apex Steel Corporation, 50 Church St., New York.
Blum & Co., Julius, 510 W. 24th St., New York.
Boker & Co., Inc., H., 101 Duane St., New York.
Colonial Steel Co., Pittsburgh, Pa.
Firth-Sterling Steel Co., McKeesport, Pa.
Frasse & Co., Inc., Peter A., 417 Canal St., New York.
Halcomb Steel Co., Syracuse, N. Y.
Hawkridge Bros. Co., Boston, Mass.
Haynes Stellite Co., Kokomo, Ind.
Heller Bros. Co., Newark, N. J.
Latrobe Electric Steel Co., Latrobe, Pa.
Onondaga Steel Co., Syracuse, N. Y.
Standard Alloys Co., Pittsburgh, Pa.
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Vanadium-Alloys Steel Co., Pittsburgh, Pa.
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Aborn Steel Co., Inc., 26 Clarke St., New York.
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National Scale Co., Chicopee Falls, Mass.
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Stellite
Haynes Stellite Co., Kokomo, Ind.

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Armstrong Mfg. Co., 297 Knowlton St., Bridgeport, Conn.
Bay State Tap & Die Co., Mansfield, Mass.
Brubaker & Bros., W. L., 50 Church St., New York.
Butterfield & Co., Derby Line, Vt.
Card Mfg. Co., S. W., Mansfield, Mass.
Carpenter Tap & Die Co., J. M., Pawtucket, R. I.
Curtis & Curtis Co., Bridgeport, Conn.
Greenfield Tap & Die Corp., Greenfield, Mass.
Hart Mfg. Co., E. 20th St. and Marion Ave., Cleveland, O.
Morse Twist Drill & Mch. Co., New Bedford, Mass.
Oster Mfg. Co., Cleveland, O.
Pratt & Whitney Co., Hartford, Conn.
Reed Mfg. Co., Erie, Pa.
Saunders Sons, Inc., D., Yonkers, N. Y.
Standard Engineering Co., Ellwood City, Pa.
Walworth Mfg. Co., Boston, Mass.

Stones, Oil
Norton Co., Worcester, Mass.
Vitrified Wheel Co., Westfield, Mass.

Stools, Steel
See Furniture, Shop and Drafting-room.

Straightening Machinery
Morse Twist Drill & Machine Co., New Bedford, Mass.
Niles-Bement-Pond Co., 111 Broadway, New York.
Springfield Mch. Tool Co., Springfield, O.

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Langelier Mfg. Co., Providence, R. I.
Torrington Co., Torrington, Conn.

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Westinghouse Elec. & Mfg. Co., East Pittsburgh, Pa.

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Bristol Co., Waterbury, Conn.
Brown Instrument Co., Philadelphia, Pa.
Veeder Mfg. Co., 39 Sargeant St., Hartford, Conn.

Taper and Form Turning Attachment
Townsend Mfg. Co., H. P., Hartford, Conn.

Taper Arbors
Parker Mfg. Co., Ann Arbor, Mich.

Tapes, Measuring
Keuffel & Esser Co., Hoboken, N. J.
Starrett Co., L. S., Athol, Mass.

Tap Extensions
Allen Mfg. Co., Hartford, Conn.

Tap Extractors
Walton Co., Hartford, Conn.

Tapping Attachments and Devices
American Tool Works Co., Cincinnati, O.
Baker Bros., Toledo, O.
Barnes Co., W. F. & John, 231 Ruby St., Rockford, Ill.
Beaman & Smith Co., Providence, R. I.
Bicknell-Thomas Co., Greenfield, Mass.
Cincinnati Bickford Tool Co., Oakley, Cincinnati, O.
Defiance Machine Works, Defiance, O.
Errington Mechanical Laboratory, 39 Cortlandt St., New York.
Geometric Tool Co., New Haven, Conn.
Greenfield Tap & Die Corp., Greenfield, Mass.
Hammond Mfg. Co., Cleveland, O.
Leland-Gifford Co., Worcester, Mass.
Modern Tool Co., 2nd and State Sts., Erie, Pa.
Newman Mfg. Co., Cincinnati, O.
Peter Bros. Mfg. Co., 135 Railroad Ave., Algonquin, Ill.
Procunier, Wm. L., 549 Washington Blvd., Chicago, Ill.
Whitney Mfg. Co., Hartford, Conn.

Tapping Machines
Acme Machinery Co., Cleveland, O.
Baker Bros., Toledo, O.
Burke Mch. Tool Co., Conneaut, O.
Defiance Machine Works, Defiance, O.
Fenn Mfg. Co., Hartford, Conn.
Garvin Mch. Co., Spring and Varick Sts., New York.
Geometric Tool Co., New Haven, Conn.
Hammond Mfg. Co., Cleveland, O.
Harrington, Son & Co., Inc., Edwin, Philadelphia, Pa.
Harris Engineering Co., H. E., Bridgeport, Conn.
Langelier Mfg. Co., Providence, R. I.
Moline Tool Co., Moline, Ill.
National Acme Co., Cleveland, O.
National Mchy. Co., Tiffin, O.
Paragon Gear Works, Taunton, Mass.
Peter Bros. Mfg. Co., 135 Railroad Ave., Algonquin, Ill.
Procunier, Wm. L., 549 W. Washington Blvd., Chicago, Ill.
Rickert-Shafer Co., Erie, Pa.
Rockford Drilling Mch. Co., Rockford, Ill.
Saunders' Sons, Inc., D., Yonkers, N. Y.
Webster & Perks Tool Co., Springfield, O.

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Advance Tool Co., Cincinnati, O.
Bay State Tap & Die Co., Mansfield, Mass.
Bealy & Co., Chas. H., 120-B N. Clinton St., Chicago, Ill.
Brubaker & Bros., W. L., 50 Church St., New York.
Butterfield & Co., Derby Line, Vt.
Card Mfg. Co., S. W., Mansfield, Mass.
Carpenter Tap & Die Co., J. M., Pawtucket, R. I.
Geometric Tool Co., New Haven, Conn.
Greenfield Tap & Die Corp., Greenfield, Mass.
Hammacher, Schlemmer & Co., 4th Ave. and 13th St., New York.
Hardinge Bros., Inc., Berteau and Ravenswood Aves., Chicago, Ill.
Harris Engineering Co., H. E., Bridgeport, Conn.
Landis Mch. Co., Inc., Waynesboro, Pa.
Morse Twist Drill & Mch. Co., New Bedford, Mass.
National Acme Co., Cleveland, O.
Pratt & Whitney Co., Hartford, Conn.
Reiff & Nestor Co., Lykens, Pa.
Saunders' Sons, Inc., D., Yonkers, N. Y.
Sheffield Mch. & Tool Co., Dayton, O.
Standard Tool Co., Cleveland, O.
Walworth Mfg. Co., Boston, Mass.

Taps, Collapsing
Errington Mechanical Laboratory, 39 Cortlandt St., New York.
Geometric Tool Co., New Haven, Conn.
Manufacturers Equipment Co., 200 N. Jefferson St., Chicago, Ill.
Modern Tool Co., 2nd and State Sts., Erie, Pa.
Murchey Mch. & Tool Co., 31 Porter St., Detroit, Mich.
National Acme Co., Cleveland, O.
Victor Tool Co., Waynesboro, Pa.

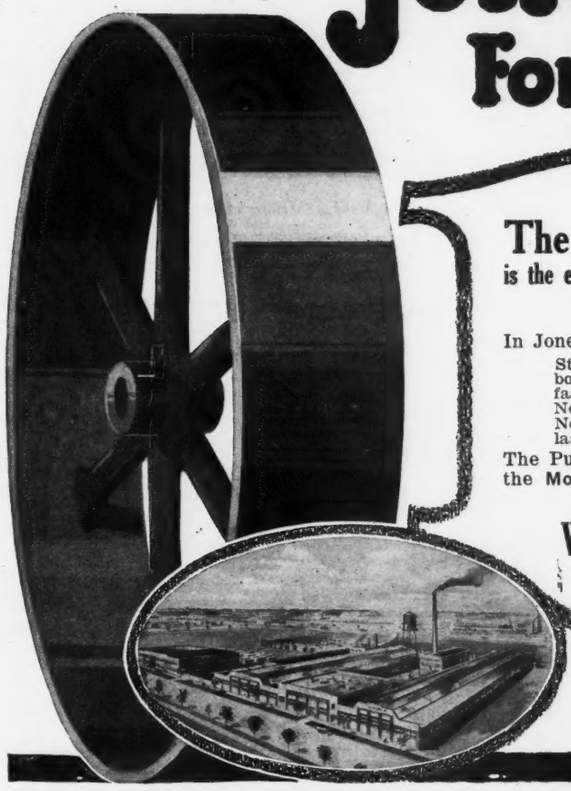
Testing Machines, Sheet Metal
Holz, Herman A., Metropolitan Bldg., New York.

Testing Outfits, Hydraulic
Metalwood Mfg. Co., Detroit, Mich.

Thermometers
Bristol Co., Waterbury, Conn.
Brown Instrument Co., Philadelphia, Pa.
Taylor Instrument Companies, Rochester, N. Y.

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Brown Instrument Co., Philadelphia, Pa.
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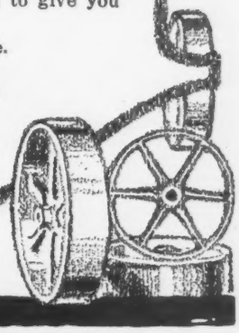
The Pulleys you buy should have these features to give you the **Most** Service at **Least** Cost.

Our large new plant is at your service.

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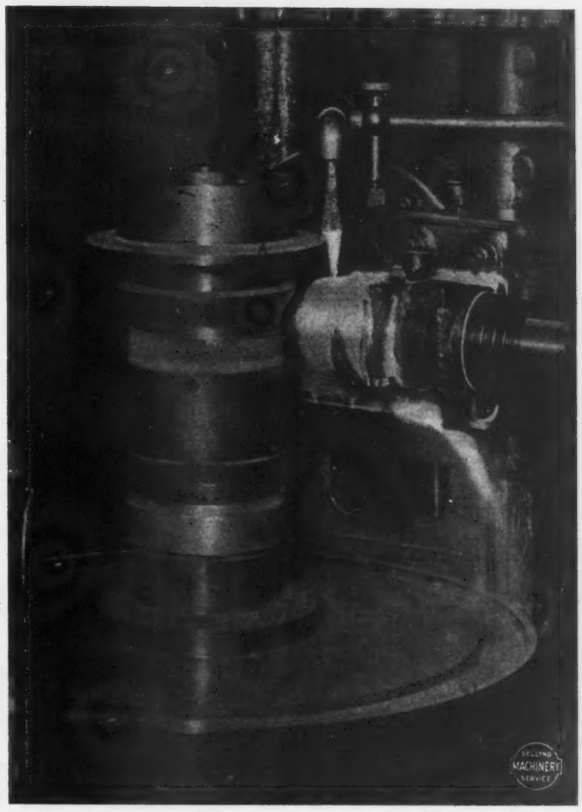
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Lees-Bradner Co., Cleveland, O.
National Acme Co., Cleveland, O.
National Mchy. Co., Tiffin, O.
Newton Mch. Tool Works, Inc., 23rd and Vine Sts., Philadelphia, Pa.
Oster Mfg. Co., Cleveland, O.
Pratt & Whitney Co., Hartford, Conn.
Rivett Lathe & Grinder Co., Brighton, Boston, Mass.
Webster & Perks Tool Co., Springfield, O.

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Newton Mch. Tool Works, Inc., 23rd and Vine Sts., Philadelphia, Pa.

Thread Cutting Tools
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Goddard Tool Co., Chicago, Ill.

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Thread Lead Indicator
Bicknell-Thomas Co., Greenfield, Mass.

Thread Milling Machines
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Gray Mch. Tool Co., Inc., Buffalo, N. Y.
Greenfield Tap & Die Corp., Greenfield, Mass.
Harrington, Son & Co., Inc., Edwin, Philadelphia, Pa.
Lees-Bradner Co., Cleveland, O.
Newton Mch. Tool Works, Inc., 23rd and Vine Sts., Philadelphia, Pa.
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Bruno Mfg. Co., Buffalo, N. Y.
Cleveland Twist Drill Co., Cleveland, O.
Gisholt Machine Co., Madison, Wis.
Hammacher, Schlemmer & Co., 4th Ave. and 13th St., New York.
Lovejoy Tool Co., Inc., Springfield, Vt.
O. K. Tool Holder Co., Shelton, Conn.
Osgood Tool Co., J. L., Buffalo, N. Y.
Ready Tool Co., 650 Railroad Ave., Bridgeport, Conn.
Western Tool & Mfg. Co., Springfield, O.
Williams & Co., J. H., 61 Richards St., Brooklyn, N. Y.
Windau Tool Co., Cleveland, O.

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Glenzer Co., J. C., Detroit, Mich.
Gorham Tool Co., Detroit, Mich.
Milwaukee Electric Crane Co., Inc., Milwaukee, Wis.

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See Cabinets, Filing.

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Harrington, Son & Co., Inc., Edwin, Philadelphia, Pa.
Northern Engineering Works, Detroit, Mich.
Yale & Towne Mfg. Co., 9 E. 40th St., New York.

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Elwell-Parker Electric Co., Cleveland, O.

Transformers
Eck Dynamo & Motor Co., Belleville, N. J.
General Electric Co., Schenectady, N. Y.
Reliance Elec. & Eng. Co., 1056 Ivanhoe Road, Cleveland, O.
Westinghouse Electric & Eng. Co., East Pittsburgh, Pa.

Transmission Machinery
See Hangers, Shafting, Pulleys, Clutches, Couplings, Belting, Chain, etc.

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Box & Co., Inc., Alfred, Philadelphia, Pa.
Chisholm-Moore Mfg. Co., Cleveland, O.
Curtis Pneumatic Mchy. Co., 1568 Kienlen Ave., St. Louis, Mo.
O M S Co., 1763 Elston Ave., Chicago, Ill.
Shepard Electric Crane & Hoist Co., Montour Falls, N. Y.
Wright Mfg. Co., Lisbon, O.
Yale & Towne Mfg. Co., 9 E. 40th St., New York.

Trucks
Barrett-Cravens Co., 713 Transportation Bldg., Chicago, Ill.
Cowan Truck Co., 88 Water St., Holyoke, Mass.
Elwell-Parker Electric Co., Cleveland, O.
Holyoke Truck Co., 112 Race St., Holyoke, Mass.
Greenfield Tap & Die Corp., Greenfield, Mass.
National Scale Co., Chicopee Falls, Mass.
Transmission Ball Bearing Co., Inc., Buffalo, N. Y.

Trucks, Electric Elevating
Elwell-Parker Electric Co., Cleveland, O.

Trucks, Elevating
Barrett-Cravens Co., 713 Transportation Bldg., Chicago, Ill.
Cowan Truck Co., 88 Water St., Holyoke, Mass.
Holyoke Truck Co., 112 Race St., Holyoke, Mass.
National Scale Co., Chicopee Falls, Mass.
Transmission Ball Bearing Co., Inc., Buffalo, N. Y.

Tube Expanders
Watson-Stillman Co., 192 Fulton St., New York.

Tubing, Flexible
Almond Mfg. Co., T. R., 2 Maple Ave., Ashburnham, Mass.
Wheelock Mfg. Co., Wheelock, Vermont.

Tubing, Seamless Steel
Blum & Co., Julius, 510 W. 24th St., New York.
Frasse & Co., Inc., Peter A., 417 Canal St., N. Y.
National Tube Co., Pittsburgh, Pa.
Standard Parts Co., Cleveland, O.

Tubing, Steel
Blum & Co., Julius, 510 W. 24th St., New York.
Frasse & Co., Inc., Peter A., 417 Canal St., N. Y.
National Tube Co., Pittsburgh, Pa.

Tumbling Barrels
Abbott Ball Co., Elmwood, Hartford, Conn.
Baird Mch. Co., Bridgeport, Conn.
Royersford Fdry. & Mch. Co., 54 N. 5th St., Philadelphia, Pa.

Turntables
Canton Foundry & Mch. Co., Canton, O.
Link-Belt Company, Chicago, Ill.

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Almond Mfg. Co., T. R., 2 Maple Ave., Ashburnham, Mass.
Meisselbach-Catucci Mfg. Co., 27 Congress St., Newark, N. J.
Newman Mfg. Co., Cincinnati, O.
Phoenix Mfg. Co., Eau Claire, Wis.

Turret Lathes, Vertical
Bullard Mch. Tool Co., Bridgeport, Conn.
Pratt & Whitney Co., Hartford, Conn.

Twist Drills
See Drills, Twist.

Unions
Dart Mfg. Co., E. M., Providence, R. I.

Universal Joints
Baush Mch. Tool Co., Springfield, Mass.
Boston Gear Works, Norfolk Downs, Mass.
Cooper Flexible Transmission Co., Inc., Brooklyn, N. Y.

Valve Leathers
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Vise Jaws
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Vises, Bench
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New Britain Mch. Co., New Britain, Conn.
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Vises, Drill
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Vises, Universal Machine
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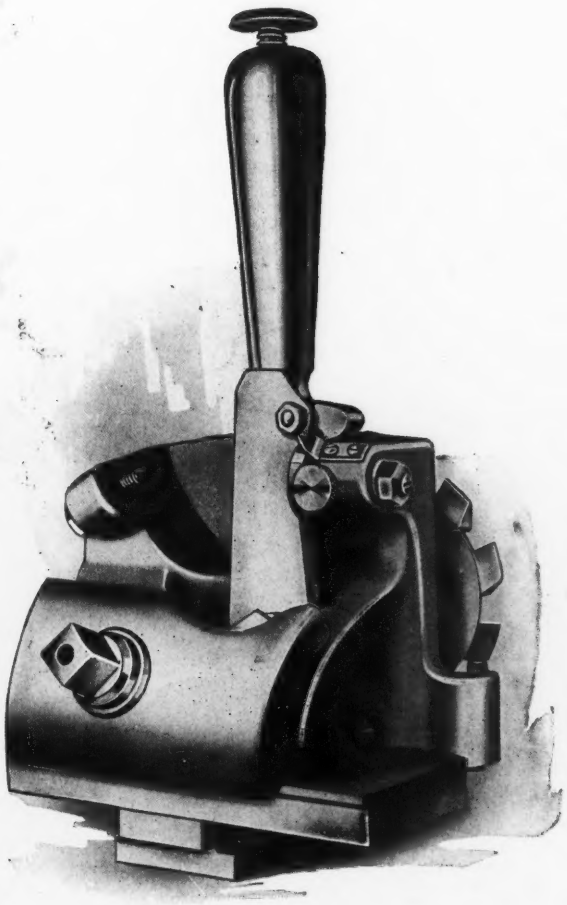
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